Quivira National Wildlife Refuge

Vegetation Mapping Project

2010-2011




Produced by Kimberly Farr (Biological Technician) and Rachel Laubhan (Refuge Biologist)
Quivira National Wildlife Refuge, Stafford, Kansas
with mapping assistance from Melanie Olds

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Executive Summary

Quivira National Wildlife Refuge (QNWR) includes 22,135 acres of diverse sand prairie grassland, wetland, and woody vegetation communities at various stages of succession. The topology is flat with raised sandhills and natural and man-made depressions. Alterations to the landscape and natural resources at multiple spatial and temporal scales contribute to current vegetation conditions. While the refuge was established in 1955, a detailed vegetation map was not available for management purposes. With the present development of a biological program and Comprehensive Conservation Plan (CCP), a baseline vegetation map of the refuge was identified as a necessity. Development of the vegetation map and associated report was a multi-step process. Aerial photography (NAIP, 2008) was used with eCognition to create polygons of different plant communities based on the likeness of surrounding pixels in the area. Prior to ground-truthing, the following activities were accomplished: training on vegetation mapping using GIS (previous experience and National Conservation Training Center course), creation of an vegetation association and alliance dichotomous key, development of a refuge plant key and identification skills, and preparation of maps for ground truthing. Once out in the field dominant plants were identified for appropriate vegetation alliance and association classification, plant specimens were collected for the refuge herbarium as necessary and additional observations and photos were gathered for the report. Over the course of the project, classification data was entered into a GIS and polygons were appropriately modified to create the final map. At Quivira, results found a total of 42 alliances and 43 associations. Of those, 23 Alliances and 24 associations were refuge specific (not included in NVCS lists). The most dominant plants throughout the refuge in 2008 based on canopy cover were saltgrass, plum, little bluestem and cottonwood. The number of alliances and associations found on the refuge show high species diversity.

Background

Quivira National Wildlife Refuge was established in 1955 largely for the habitat characteristics and location that benefit migrating and wintering birds. A Comprehensive Conservation Plan is being developed for QNWR largely to evaluate the habitat and management potential and to form goals and objectives that guide management over the next 15 years. A current vegetation map was identified as a need to facilitate decision-making early in the planning process. While historic refuge vegetation information is available for most areas of the refuge (e.g., 1954 appraisal map, Big Salt Marsh study from the early 1960's, a few range surveys >10 years old), no known information exists that informs management of a current baseline vegetation map.

Land use in and around QNWR in past and recent years continues to alter plant community patterns on and off refuge lands. Management activities in the past >50 years have been greatly motivated by water availability within and among years. In years immediately prior to establishment, areas on the refuge were used for farming, ranching, and hunting, especially for waterfowl. Some ditches and dikes were built by private duck clubs to hold water higher and longer in certain wetland areas to improve hunting conditions, especially in relatively dry years. Possibly the most significant single hydrological change on refuge lands occurred in the late 1920's or early 1930's when a ditch was dug to force the Rattlesnake Creek to flow directly into the Little Salt Marsh. After refuge lands were acquired, the Fish and Wildlife Service created many additional water impoundments, again largely to benefit migrating and wintering birds. Management often uses a combination of strategies to accomplish varied purposes, such as control of invasive trees, woody, and herbaceous vegetation. In conjunction with natural events (e.g., climate), changing management philosophies over the years have differentially affected refuge lands with varied strategies and capabilities of flooding, drying, grazing, burning, haying, chemical and mechanical disturbance. Further, changes in land use at a landscape scale have caused regional declines in groundwater, especially during the growing season when pumping activities occur. Collectively, land use changes at multiple scales are likely having various short- and long-term impacts on vegetation conditions on the refuge.

QNWR includes 22,135 acres of diverse sand prairie grassland, wetland, and woody vegetation communities at various stages of succession (Figure 1). Refuge topology is fairly flat with slight rises over sand hills and subtle depressions where various wetland types occur (e.g., natural and artificial drainages and basins). Water unit topology varies; some have raised upland areas where saltgrass of other wetland plants grow, most gradually slope to control structures, and some areas contain borrow ditches that the refuge is in the process of filling and recontouring. Some units have erosional and depositional forces that act along parts of Rattlesnake Creek, which generally flows from southwest to northeast through the refuge and is the main source of surface water.

Quivira is in the transition zone of eastern and western prairie ecosystems, where both short and tall grass communities occur. Presently, based on these mapping project results, there are about 4898.4 acres of grassland on Quivira. While some areas are still farmed on the refuge (not included as grassland), current plans involve eventual reconstruction of these sites to native prairie by gradually phasing out areas out of agriculture production. Grasslands are dominated by warm season grasses but cool season grasses, such as Canada wildrye (*Elymus canadensis*) and Creeping

Wildrye (*Elymus repens*), are noticeable in varying amounts in the spring/early summer in most grassland communities on the refuge. The most common grassland plants are little bluestem (*Schizachyrium scoparium)*, big bluestem (*Andropogon gerardii*), switchgrass (*Panicum virgatum*), and Indiangrass (*Sorghastrum nutans*).

The refuge's extensive and diverse wetland vegetation communities (10,815.2 acres), include those associated with semi-permanent, seasonal, and temporary palustrine systems, salt marsh, riverine, riparian, springs, and meadow. The Big and Little Salt Marshes and several permanent or semi-permanent waters occurred in the area historically, but much of the present wetland area was artificially created or enhanced and managed through a series of water control structures. Natural water sources include seeps or springs, precipitation, and Rattlesnake Creek, which flows through the length of the refuge. Many wetland areas are drained naturally and artificially to encourage nutrient cycling and plant growth of annuals. Periodic flooding of these sites in spring and/or fall increases availability of food resources primarily to benefit migrating birds. Some smaller natural wetland areas on the refuge have been adversely impacted as trees have been allowed to become the dominate canopy vegetation. Present and future tree removal efforts should largely restore these areas back to temporary/seasonal herbaceous wetland types. Some common wetland plants presently found on the refuge are cattail (*Typha spp.*), salt cedar (*Tamarix ramosissima*), three-square (*Schoenoplectus pungens*), and saltgrass (*Distichlis spicata*).

Woody vegetation on the refuge is in the form of tree stands or rows and shrub stands/mottes. The tree stands on the refuge generally are the result of historic plantings for timber, to prevent soil erosion (which dates back to soil stabilization issues during the dust bowl), and a couple of volunteer conservation projects. Also, invasive trees have invaded refuge lands from neighboring areas. The refuge is now actively trying to reduce tree coverage and increase area of native prairie. Some of the most common trees on the refuge are black locust (*Robinia pseudo-acacia*), red cedar (*Juniperus virginiana*), cottonwood (*Populus deltoide*), and northern catalpa (*Catalpa speciosa*). Shrub stands are primarily plum (mostly sandhill [sand] plum with small amounts of American plum) in the upland with large amounts of sumac only in a few areas on the refuge and far lesser amounts of willow on wetter sites. All these shrub types are native and productive from a wildlife habitat perspective. However, plum has gradually increased in place of grassland prairie communities as a result in disruptions in natural processes, thereby causing shifts in wildlife habitat availability and use. In recent years, management has been managing to reduce shrub cover through a combination of mechanical disturbance (mowing) and fire management to benefit species guilds associated with both open prairie and shrub habitat.

Figure 1. The project boundary for vegetation mapping at Quivira National Wildlife Refuge.

Methods

This mapping project was conducted from spring 2010 through fall 2011 and involved many steps.

1. *Acquisition of aerial imagery*
   Aerial imagery is four band with a 1-meter ground resolution (NAIP, 2008; cite the aerial imagery was taken in infrared, in the summer of 2008, because this spectrum is well reflected by plants and it allows plant communities to be differentiated (Figure 2). The imagery was post processed, georeferenced, and projected in UTM 14 NAD 83 to be used in ArcMap 9.3.

2. *Review and evaluation of recent methods and experiences on other National Wildlife Refuges*
   Biologist gathered and reviewed literature related to vegetation mapping and contacted the Habitat and Population Evaluation Team (HAPET) and several field biologists who recently developed baseline vegetation maps. Information was considered collectively in the context of QNWR setting, logistical considerations, and management needs.

3. *Training*
   Biologist provided Biological Technician with NVCS information, NAIP imagery, many plant identification sources, and other refuge-specific information. Necessary information (objectives, environmental considerations, equipment capabilities, NAIP imagery) was prepared for use as a project during a week-long training course on vegetation mapping using GIS at the National Conservation Training Center.

4. *Classification of Vegetation*
   In compliance with USFWS policy, National Vegetation Classification Standard (NVCS) vegetation alliances and associations were used to label and describe communities. NVCS is a classification hierarchy that consists of seven levels. The first 5 levels deal with plant physiognomy and consist of the categories from highest to lowest levels class, subclass, group, subgroup, and formation. Class is a combination of general dominant growth forms that are adapted to basic temperature, moisture, and substrate/aquatic conditions. Subclass is combinations of general dominant and diagnostic growth forms that reflect global macroclimatic factors driven primarily by latitude and continental position, or that reflect overriding substrate/aquatic conditions. Group is a combination of life form structural and abiotic attributes. Subgroup splits vegetation up into natural/semi natural or planted/cultivated. Formation is the ecological grouping of vegetation units with broadly defined environmental and additional physiognomic factors in common.

   The last two levels of NCVS are Floristic and consist of plant alliances and associations. Each Alliance is a group of associations that have a dominant species in the highest strata. An association contains the dominant species from the alliance level but it also addresses other dominant species that occur in other strata in the plant community.

   At the beginning of the project NVCS classifications known to exist in Kansas were reviewed. Classifications were eliminated if dominant plants did not occur in south central Kansas. Once

mapping started, new categories were identified and added to the refuge list as needed. There, community types received a Quivira code and were described in a vegetation key for consistent identification. Dr. Kelly Kindscher (Senior Scientist, Kansas Biological Survey) and the Nature Serve website technicians provided technical assistance with vegetation classifications appropriate for the refuge. Once a comprehensive list of alliances and associations was compiled for the refuge, information was collated into a dichotomous key for use in the field.

5. *Delineation of Vegetation Community Boundaries*

Infrared imagery of the refuge was run with eCognition software as an efficient, objective, and repeatable method of defining vegetation community boundaries (Division of Planning, Mike Artmann; Figure 3). The results found various vegetation wave lengths correspond with specific types of plant communities at 100 pixels; similar proximate color pixels were combined to create a polygons (hereafter termed eCog polygons) at least 0.5 acres (although some areas were delineated to 0.20 manually). The resulting mapping information was uploaded into Refuge Lands Geographic Information System (RLGIS). While post-data collection polygon manipulation was at times necessary, it was determined that the level at which the eCog software was run was appropriate considering the majority of polygons adequately captured major transitions in vegetation associations. At the same time, it was determined that most polygons required ground truthing for accurate classification due to subtle variations in different vegetation types.

6. Ground truthing (identify vegetation signatures and validate map)

Ground truthing is necessary in order to identify unique map/photo signatures of vegetation and to test/validate the accuracy of the remotely sensed data. Imagery can be difficult to interpret due to a number of factors including subtle differences in vegetation characteristics, shadows from tree canopy closure that cause distortion, spatial overlapping/layering of vegetation, and rapid changes in plant communities due to removal operations, restoration, and time of year.

Field seasons occurred from July to November 2010 and June to October 2011. In order to identify plants synonymous with the alliances and associations in the field, a dichotomous plant key was appropriately adapted from NVCS (i.e., only included alliances and associations potentially occurring on the refuge). Plant identification information was also prepared to be used with the key. Color infrared imagery displaying eCog polygon boundaries were uploaded into the GPS (Trimble Geo XT 2008 series) to facilitate mapping in the field. Printed maps and GPS were used to record field data related to vegetation classification and conditions, and to verify mapping locations and boundaries. Often in planning field work, areas to be surveyed were defined by evident physical boundaries, such as roads, fences, ditches, sources of water, or tree stands. In total, approximately 95% of polygons in the field were visited. Thus, the resulting map is highly accurate.

A list of alliances and associations suspected to be in the survey area were downloaded into the RLGIS database program which also allowed them to be seen on the GPS unit in the field. The data entry form on the unit followed the data entry form that was the default in the RLGIS.

The information was accessed in ArcPad 7.11 on the unit. Data entered into the RLGIS data form was Plant Physiognomic levels, alliance, association, and percentage of the landscape consisting of each of the non-dominant alliance and association related plants. The coverage percentages were 60-25%, 25-10%, 10-1%, and <1%.

Before going out into the field, polygons were recut and cleaned up for any obvious errors in the imagery. Once out in the field, GPS was used to navigate to the desired polygon either by walking or via a UTV. Once arriving at a polygon, the entire or a sizable area of a given polygon was walked and a visual estimate of the percentage of each plant species present at the site was recorded (see vegetation classification key and NVCS guidance). Dominant species were the plants with the highest aboveground cover or representation at the site, and determined which alliance the polygon was assigned. To be a dominant or codominant species a plant had to make up at least 10% of the vegetation cover in the polygon. In some cases of codominant plants, there was unequal coverage but both plant types had to be present in at least 10% of the area. In the case of invasive plants, they were only considered dominant if it was impossible to identify another plant community that made up 10% of the vegetation. Since Cheatgrass is in small amounts in much of the grassland area on the refuge, only areas that were dominant or fell into the 25%-60% range were recorded. At some sites, a majority of the area was covered by forbs and the dominant forb species were not made into alliances and associations because forbs are not recognized by NVCS because they are not a long lasting part of the landscape (many early successional plants; annuals, biannuals). At these sites, polygons were vigorously searched for 10% of any other plant community type.

Therefore, once the dominant plant has been classified, the dichotomous plant key was used to see which alliance(s) and association(s) best represented the site. This data was collected as well as any other dominant plants from other associations were noted with their percent abundance. This data was manually written into a paper map and recorded using 2 to 3 letter acronyms. The association was circled and percent abundance category for other species was recorded. At the beginning of the project information was also recorded in the GPS but major problems with the unit occurred, therefore the hardcopy aerial photo map with handwritten notes became the main method of data collection. Other observations gathered included factors related to invasive species occurrence that would not otherwise be captured at the mapping scale.

The first and second years of mapping experienced above and below ‘normal’ precipitation on the refuge, respectively. Climate impact on plant growth was observed in cases where grazing or fire did not occur. Standing dead and live vegetation were both used to determine alliances and associations. In areas that had been treated (e.g., mowing, grazing), treatment records and management staff were consulted to ascertain what was seen on the site. Habitat management prescription plans and actual treatments were being documented in RLGIS and refuge files by other staff.

7. Data Entry

Once back in the office, data was entered into GIS including the plant system, class, height class, subclass, group, subgroup, formation, NVCS Alliance and NVCS Alliance. Adjacent polygons with matching associations and non-dominant representations from other plant communities were combined, polygons composed of multiple distinct association types were divided or digitized into separate polygons, and new polygon boundaries were drawn to align with results of ground surveys. The minimum mapping unit was 0.2 acres for a polygon or a closely-spaced distribution of polygons (as in the case of groups of trees or plum) that equaled at least 0.2 acres. Certain dominant plants had distinct signatures on the infrared imagery that was verified in the field often enough to allow classification of associations with use of imagery alone. These associations picked up well by the imagery alone were visited ≥ 10% for each association type and 100% of the time it was the same plant. Dominant plant types with strong infrared imagery signatures on QNWR at this time include cattail, common reed, bare ground, water, plum, buildings, roads, and pure stands of saltgrass. While plum showed a strong signature, depending on the surrounding vegetation, ground-truthing was required to adequately delineate all plum coverage at the desired scale. Also in a few cases other shrubs like sumac, dogwood, or willow looked similar to plum on the aerial imagery. One vegetation type, prairie dog town grassland complex, was manually surveyed on the ground at all locations. Once all the data related to the polygons was entered and appropriately refined, it was checked for errors. Then the completed map was saved and printed for future use.

Figure 2: An example of infrared photography flown over the refuge.

Figure 3: An example of infrared imagery after it was run through eCognition software.

Results & Discussion

Based on the mapping methods implemented (using 2008 photos), Quivira has a total of 42 alliances and 43 associations. Of those, 22 alliances and 23 associations are refuge-specific categories not found in NVCS lists. These plant categories include 15 tree, 5 shrub, and 20 herbaceous communities. The number of alliances and associations found on the refuge demonstrate high species diversity. Herbaceous wetland associations comprise 48.6% of the total refuge coverage with the most abundant wetland plants being saltgrass, cattail, and three-square. The most abundant wetland association is saltgrass with 22.1% of the coverage or 4926.1 acres. Grassland associations comprise 22% of the total coverage with the most abundant grassland species being little bluestem, switchgrass, and indiangrass. The most abundant grassland association is Little Bluestem with 9.2% of the total coverage or 2058.8 acres. Shrubs comprise 6.6% of the coverage with the most abundant shrubs being plum and Tamarisk (salt cedar). The most abundant shrub is plum with 5.5% of the total coverage or 1231.1 acres. Trees comprise 3.9% of the coverage. The most abundant trees are locust, Russian olive, and cottonwood. The most abundant association is Cottonwood with 1.7% of the coverage or 389.5 acres.

In the course of mapping there were a few vegetation patterns that were unique to certain areas of the refuge. The Dogwood-plum alliance is only found in the natural areas section of the refuge. Sumac, although found in small patches around the refuge, largely occurrs in Dead Horse Slough. Black Willow occurs in the North Lake section of the refuge around the road to Mandalay. Soapberry occurs only along the Rattlesnake Creek in two areas of the 12b unit of the refuge. Buffalograss is surprisingly sparse on the refuge (seemingly more abundant historically based on original refuge appraisal map); and only located in abundance in two areas of the refuge. The Prairie Dog Towns are isolated to the East end of the East Salt Creek Unit. There is one area where box elder is dominant at the southern end of the refuge. Common reed is mainly concentrated around the Little Salt Marsh area, but much smaller infestations are widely scattered (and quickly treated upon discovery) over different parts of the refuge.

The great diversity of the refuge is partly due to Quivira's location as a transition zone for tall and short grass prairie types and the wide range of microtopography across the landscape. Data from this project includes collection during a very wet year and a very dry year, thus certain plants might have been under- or over- represented depending on adaptations to these changing environmental conditions (multiyear effects) and coverages should be considered in this context. Also, refuge management since the topographic map of the refuge was taken in 2008 has already caused some changes in vegetation coverage (e.g., extensive management to reduce woody species coverage).

Table 1. List of Plant Alliance and Associations found at Quivira.

Scientific Name	Common Name	NCVS code
	Forest	
***Ailanthus altissima* Forest Alliance**	Tree of Heaven Forest Alliance	A.221
***Ailanthus altissima* Forest**	Tree of Heaven Forest	CEGL007191
***Catalpa speciosa* Forest Alliance**	Northern Catalpa Forest Alliance	QVR_1
***Catalpa speciosa* Forest**	Northern Catalpa Forest	QVR_1a
***Fraxinus pennsylvanica* Forest Alliance**	Green Ash Forest Alliance	QVR_28
***Fraxinus pennsylvanica* Forest**	Green Ash Forest	QVR_28a
***Gymnocladus dioica* Forest Alliance**	Kentucky Coffee-tree Forest Alliance	QVR_5
***Gymnocladus dioica* Forest**	Kentucky Coffee-tree Forest	QVR_5a
***Juniperus virginiana* Semi-natural Forest Alliance**	Red Cedar Semi-natural Forest Alliance	A.137
***Juniperus virginiana* Semi-natural Forest**	Red Cedar Semi-natural Forest	CEGL002593
***Populus deltoides* Temporarily Flooded Forest Alliance**	Cottonwood Temporarily Flooded Forest Alliance	A.290
***Populus deltoides*-Salix nigra Forest**	Cottonwood -Black Willow Forest	CEGL002018
***Robinia pseudoacacia /Gleditsia triacanthos* Forest Alliance**	Locust Forest Alliance	QVR_26
Robinia pseudoacacia/Gleditsia triacanthos Forest	Locust Forest	QVR_26a
	Woodland	
Acer Negundo Woodland Alliance	Box Elder Woodland Alliance	QVR_13

Acer Negundo Woodland	Box Elder Woodland	QVR_13a
Celtis occidentalis Woodland Alliance	Hackberry Woodland Alliance	QVR_20
Celtis occidentalis Woodland	Hackberry Woodland	QVR_20a
***Elaeagnus angustifolia* Woodland Alliance**	Russian Olive Woodland Alliance	QVR_8
***Elaeagnus angustifolia* Woodland**	Russian Olive Woodland	QVR_8a
***Maclura pomifera* Woodland Alliance**	Osage-orange Woodland Alliance	QVR_29
***Maclura pomifera* Woodland**	Osage-orange Woodland	QVR_29a
***Morus rubra* Woodland Alliance**	Mulberry Woodland Alliance	QVR_12
***Morus rubra* Woodland**	Mulberry Elm Woodland	QVR_12a
***Sapindus saponaria* Woodland Alliance**	Soapberry Woodland Alliance	QVR_30
***Sapindus saponaria* Woodland**	Soapberry Woodland	QVR_30a
***Ulmus Americana* Woodland Alliance**	American Elm Woodland Alliance	QVR_23a
***Ulmus Americana* Woodland**	American Elm Woodland	QVR_23a
***Ulmus pumila* Woodland Alliance**	Siberian Elm Woodland Alliance	QVR_6
***Ulmus pumila* Woodland**	Siberian Elm Woodland	QVR_6a

Shrubland		
***Cornus drummondii* Shrubland Alliance**	Rough leaf dogwood Shrubland Alliance	A.3558
***Cornus drummondii*- (Rhus glabra, Prunus spp.) Shrubland**	Rough leaf dogwood-(Smooth Sumac, Plum) Shrubland	CEGL005219
Prunus spp. Shrubland Alliance	Plum Shrubland Alliance	QVR_25
Prunus spp. Shrubland	Plum Shrubland	QVR_25a
***Rhus aromatica* Shrubland Alliance**	Fragrant Sumac Shrubland Alliance	QVR_17
***Rhus aromatica* Shrubland**	Fragrant Sumac Shrubland	QVR_17a
***Salix* (*exigua, interior*) Temporarily Flooded Shrubland Alliance**	Willow (Coyote, Sandbar) Temporarily Flooded Shrubland Alliance	A.947
***Salix exigua* / Mesic Graminoids Shrubland**	Coyote Willow / Mesic Graminoids Shrubland	CEGL001203
***Tamarix* spp. Semi-natural Temporarily Flooded Shrubland Alliance**	Salt Cedar Semi-natural Temporarily Flooded Shrubland Alliance	A.842
***Tamarix* spp. Semi-natural Temporarily Flooded Shrubland**	Salt Cedar Semi-natural Temporarily Flooded Shrubland	CEGL003114
Herbaceous		
Agriculture Vegetation Alliance	Agriculture Vegetation Alliance	QVR_9
Agriculture Vegetation	Agriculture Vegetation	QVR_9a
***Andropogon gerardii* - (*Calamagrostis canadensis*, *Panicum virgatum*) Herbaceous Alliance**	Big Bluestem-(Bluejoint grass, Switchgrass) Herbaceous Alliance	A. 1191
***Andropogon gerardii* - *Panicum virgatum* - *Helianthus grosseserratus* Herbaceous Vegetation**	Big Bluestem- Switchgrass- Sawtooth Sunflower Herbaceous Vegetation	CEGL002024

***Andropogon gerardii* - (*Sorghastrum nutans*) Herbaceous Alliance**	Big Bluestem-(Indiangrass) Herbaceous Alliance	A. 1192
***Andropogon gerardii* - *Sorghastrum nutans* Western Great Plains Herbaceous Vegetation**	Big Bluestem-Indiangrass Western Great Plains Herbaceous Vegetation	CEGL001464
***Andropogon hallii* Herbaceous Alliance**	Sand Bluestem Herbaceous Alliance	A. 1193
***Andropogon hallii-Calamovilfa longifolia* Herbaceous Vegetation**	Sand Bluestem-Long-leaved Reed-grass Herbaceous Vegetation	CEGL001467
Bare Ground Alliance	Bare Ground Alliance	QVR_18
Bare Ground	Bare Ground Vegetation	QVR_18a
***Bromus tectorm* Semi-natural Herbaceous Alliance**	Cheatgrass Semi-natural Herbaceous Alliance	A. 1814
Bromus tectorm Semi-natural Herbaceous Vegetation	Cheatgrass Semi-natural Herbaceous Vegetation	CEGL003019
***Distichlis spicata* - (*Hordeum jubatum*) Temporarily Flooded Herbaceous Alliance**	Saltgrass-(Foxtail Barley)Temporarily Flooded Herbaceous Alliance	A. 1341
***Distichlis spicata* - (*Hordeum jubatum*, *Poa arida*, *Sporobolus airoides*) Herbaceous Vegetation**	Saltgrass-(Foxtail Barley, Prairie Bluegrass, Alkali Sacaton) Herbaceous Vegetation	CEGL002042
***Eleocharis palustris* Temporarily Flooded Herbaceous Alliance**	Common Spikerush Temporarily Flooded Herbaceous Alliance	A. 1342
***Eleocharis palustris* - (*Eleocharis compressa*) - *Leptochloa fusca* ssp. *fascicularis* Herbaceous Vegetation**	Common Spike-rush-(Flat-stemmed Spike-rush)	CEGL002259
Grassland Complex Herbaceous Alliance	Grassland Complex Herbaceous Alliance	A.XXXX
Black tailed Prairie Dog Town Grassland Complex	Black tailed Prairie Dog Town Grassland Complex	CECX005703

***Panicum virgatum* Alliance**	Switchgrass Alliance	QVR_14
***Panicum virgatum* Herbaceous Vegetation**	Switchgrass Vegetation	QVR_14a
***Panicum virgatum- Sorghastrum nutans* Herbaceous Vegetation**	Switchgrass-Indiangrass Vegetation	QVR_14b
***Phragmites australis* Semipermanently Flooded Herbaceous Alliance**	Common Reed Semipermanently Flooded Herbaceous Alliance	A.1431
***Phragmites australis* Western North America Temperate Semi-natural Herbaceous Vegetation**	Common Reed Western North America Temperate Semi-natural Herbaceous Vegetation	CEGL001475
Sand Flats Temporarily Flooded Sparsely Vegetated Alliance	Sand Flats Temporarily Flooded Sparsely Vegetated Alliance	A. 1754
Riverine Sand Flats- Bar Sparse Vegetation	Riverine Sand Flats- Bar Sparse Vegetation	CEGL002044
***Schizachyrium scoparium - Bouteloua curtipendula* Herbaceous Alliance**	Little Bluestem- Gammagrass Herbaceous Alliance	A. 1225
***Schizachyrium scoparium - Bouteloua curtipendula* Western Great Plains Herbaceous Vegetation**	Little Bluestem- Gammagrass Western Great Plains Herbaceous Vegetation	CEGL001594
***Schoenoplectus pungens* Semipermanently Flooded Herbaceous Alliance**	Three-Square Semipermanently Flooded Herbaceous Alliance	A. 1433
***Schoenoplectus pungens* Herbaceous Vegetation**	Three-Square Herbaceous Vegetation	CEGL001587
***Schoenoplectus tabernaemontani* (*Schoenoplectus acutus*) Semi-permanently Flooded Herbaceous Alliance**	Softstem Bulrush (Hardstem Bulrush) Semi-permanently Flooded Herbaceous Alliance	QVR_16
***Schoenoplectus tabernaemontani* (*Schoenoplectus acutus*) Semi-permanently Flooded Herbaceous Vegetation**	Softstem Bulrush (Hardstem Bulrush) Semi-permanently Flooded Herbaceous Vegetation	QVR_16a

***Spartina Pectinata* Temporarily Flooded Herbaceous Alliance**	Prairie Cordgrass Temporarily Flooded Herbaceous Alliance	A. 1347
***Spartina pectinata* - *Eleocharis spp.* - *Carex spp.* Herbaceous Vegetation**	Prairie Cordgrass-Spikerush-Sedge Herbaceous Vegetation	CEGL002223
***Typha* (*angustifolia*, *latifolia*) - (*Schoenoplectus spp.*) Semipermanently Flooded Herbaceous Alliance**	Cattail(Broad-leaved, Narrow-leaved)-Bulrush Alliance	A. 1436
***Typha spp.* Great Plains Herbaceous Vegetation**	Cattail Great Plains Herbaceous Vegetation	CEGL002389
***Typha spp.* - (*Schoenoplectus spp.*, *Juncus spp.*) Seasonally Flooded Herbaceous Alliance**	Cattail (Bulrush, Rush) Seasonally Flooded Herbaceous Alliance	A. 1394
***Schoenoplectus tabernaemontani* - *Typha spp.* - (*Sparganium spp.*, *Juncus spp.*) Herbaceous Vegetation**	Softstem Bulrush-Cattail-(Bur-reed, Rush) Herbaceous Vegetation	CEGL002026
***Urochloa mutica* Herbaceous Alliance**	Buffalo grass Herbaceous Alliance	QVR_31
***Urochloa mutica* Herbaceous Vegetation**	Buffalo grass Herbaceous Vegetation	QVR_31a

*Codes that include “QVR” represent plant communities found on the refuge and not listed in the NCVS.

Recommendations

● Minimize/Avoid changes in mapping methods late in the planning process.

● Use of paper/hardcopy maps in conjunction with GPS for data collection is important to prevent loss of data due to equipment failure. And, if possible, have backup equipment available.

● Consider site conditions before heading out to the field. Access to sites may present one or more challenges that may be overcome with careful planning (e.g., transportation, equipment, and travel route requirements/decisions). There may be natural boundaries (e.g., drainages, large stands of woody or tall emergent vegetation) and/or ditches/canals that influence access points and/or travel routes. In salt grass areas a good indicator of a ditch is taller vegetation. Some of these ditches/drainages are impassible with a UTV due to large amounts of erosion. Often it is helpful to talk to staff and review the surrounding area using imagery prior to surveying areas. Permanent fencing and gates are not always mapped or available maps are not current, therefore consider alternate routes.

● Alteration of vegetation by management and natural disturbance can hinder vegetation mapping. Documentation and use of recent management activity, such as timing and location of mechanical treatements of trees or shrubs, is recommended to avoid confusion while mapping in the field. Coordination of mapping and management activities during the growing season may prevent loss of necessary vegetation information. If and when possible, areas soon to be affected by management in a way that impedes vegetation identification (e.g., cattle grazing, mowing) should be mapped first. Certain activities occurring just before the growing season have minimal impacts to mapping efforts because field work generally occurs between June and September and there is time for plant response to facilitate plant identification. Once cattle are moved to a paddock or grazing cell there is a small window of opportunity when vegetation information can still be collected. Fire usually has a minimal effect on mapping except in cases of late-season burns.

Literature Cited

Haddock, Mike. Kansas Wildflowers and Grasses. 2011. 12 Apr. 2011 <http://www.kswildflower.org/>

University of Waterloo. Tallgrass Prairie. 2011. 12 Apr. 2011 <http://www.environment.uwaterloo.ca/cooljobs/images/2008_09/titaro1.jpg>

United States Department of Agriculture Natural Conservation Services. Plants Database. 2011. 12 Apr. 2001 <http://plants.usda.gov/java/>

University of California Berkeley. CalPhotos. 2011. 12 Apr.2011 <http://calphotos.berkeley.edu/>

Nature Serve. Nature Serve: Ecological Communities and Systems. 2010 May 15 2120 <http://www.natureserve.org/explorer/servlet/NatureServe?init=Ecol>

Photos

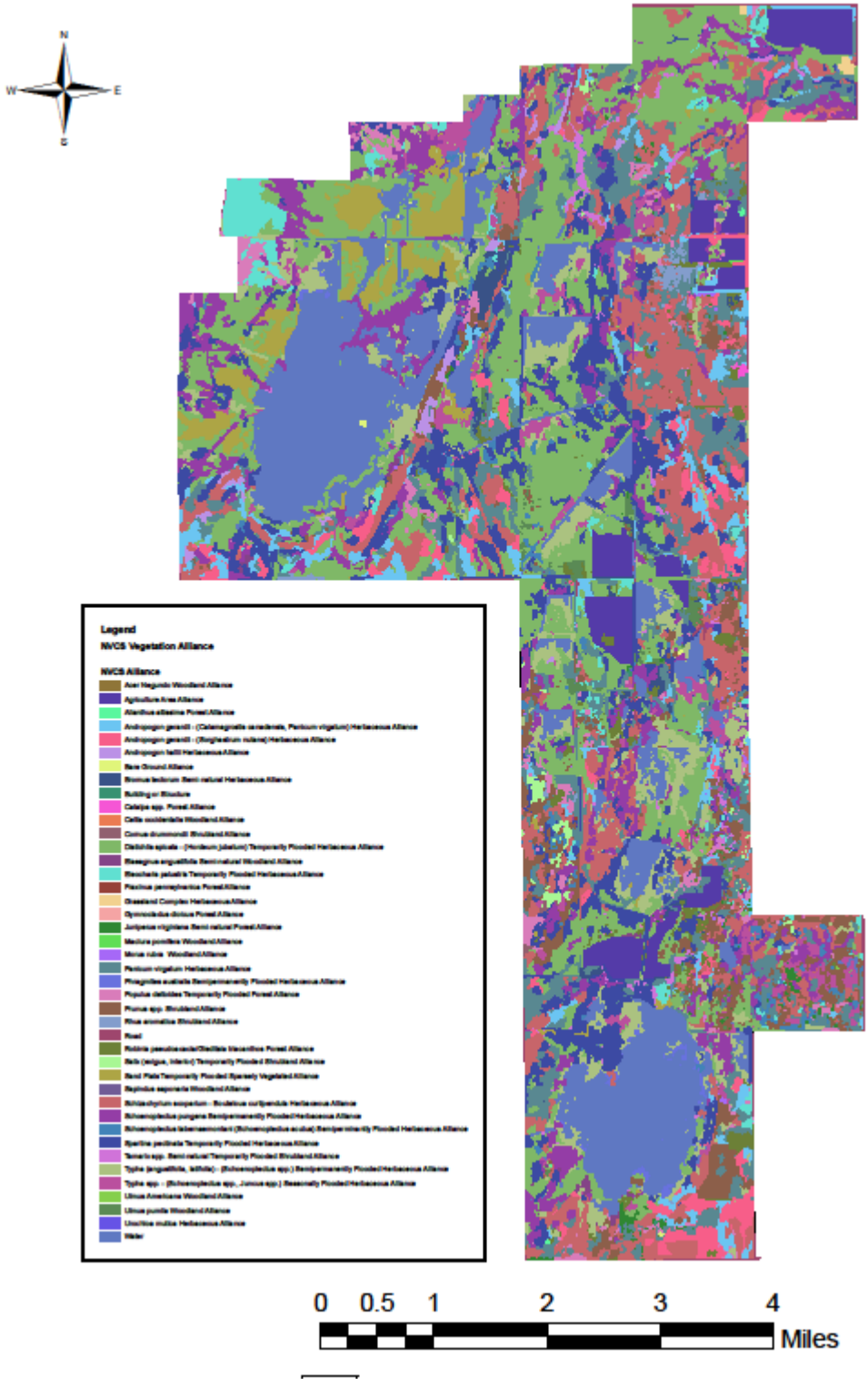
USDA Natural Resource Conservation Service. Plants Datbase. 2011 4 Apr. 2011 http://plants.usda.gov/

Lady Bird Johnson Wildflower canter. Native Plant Database. 2011 4 Apr. 2011 http://www.wildflower.org/

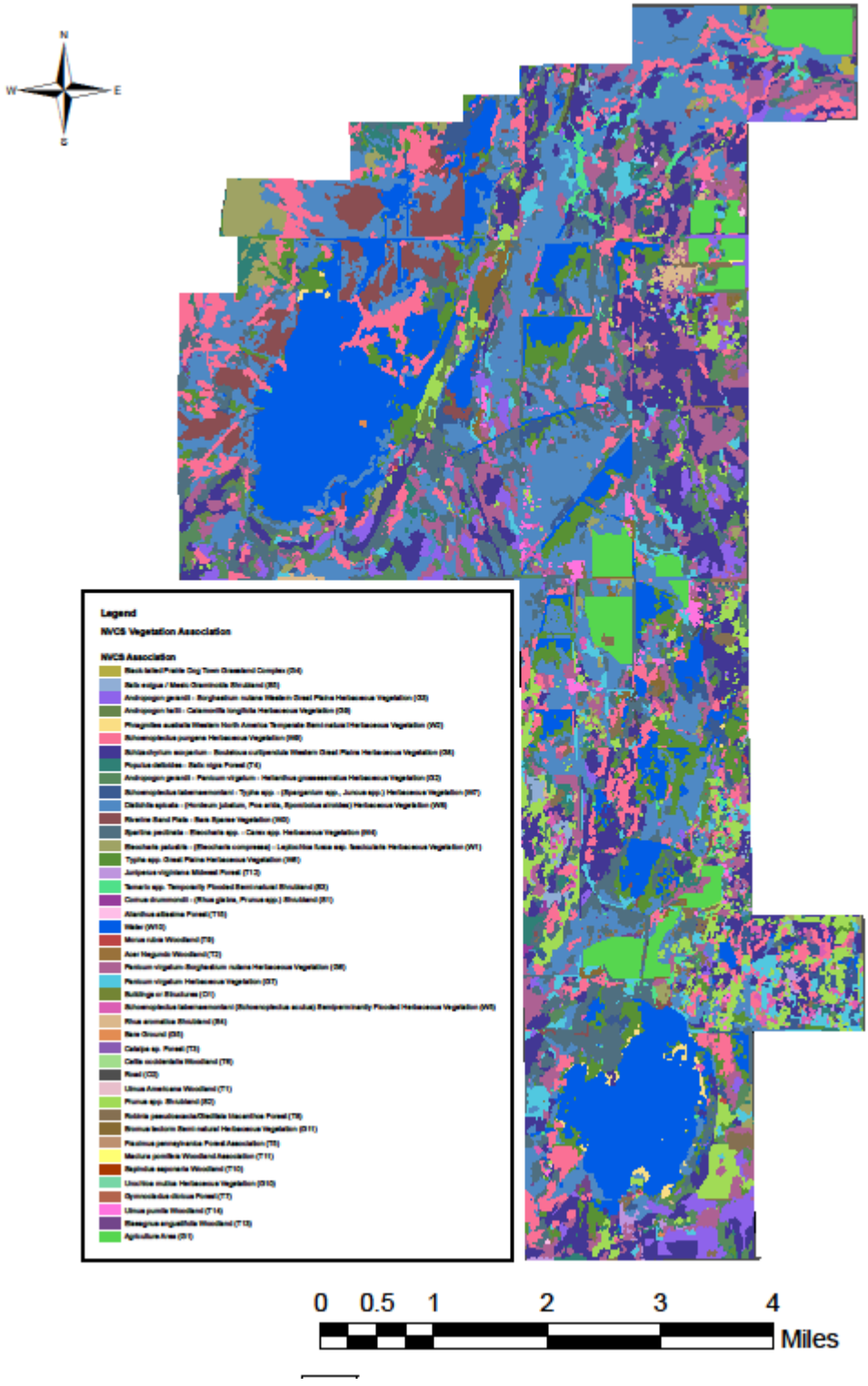
University of Wisconsin, Robert W. Freckmann Herbarium. 2011 4 Apr. 2011 http://wisplants.uwsp.edu/

Jones, Barry. Quivira Photos. 2011 4 Apr. 2011

Appendix A: NVCS Vegetation Alliances on Quivira NWR in 2008.



Appendix B: NVCS Vegetation Associations on Quivira NWR in 2008.



Appendix C: NVCS Vegetation Alliance and Association field key adapted for Quivira National Wildlife Refuge

1a. Area has 40% Tree cover or greater……. go to 2

1b. Area has below 40% Tree cover…….....go to 3

2a. Tree Cover 40-60%.....go to **Woodland**

2b. Tree Cover greater than 60%.....go to **Forest**

3a. Below 25% tree cover and has shrub that make up at least 25% of the cover ……go to **Shrubland**

3b. Less than 25% tree cover and shrub cover…….go to 4

4a. Trees and shrubs less than 25% cover and herbaceous plants make up at least 25% cover. ……...go to **Herbaceous**

4b. Total Vegetation less than 25% cover.....go to **Sparse Vegetation Forest**

Forest

1a. Tree of Heaven dominant in the canopy……go to 2

1b. Tree of Heaven not dominant in the canopy……..go to 4

2. **Ailanthus altissima Forest Alliance**

Forests dominated by the alien species Ailanthus altissima, a native of eastern Asia. This forest occurs mostly in disturbed areas, along roadsides, urban abandoned lands, and on limestone clifftops. In some parts of the range, this forest is associated with calcareous soils. Ailanthus altissima Forest occurs throughout the Appalachians, in eastern Kentucky, and in the Ozarks and Ouachita Mountains, and probably other areas in the northeastern United States……go to 3

3. **Ailanthus altissima Forest**

There is no current written description for this association in the NVCS system. At Quivira this association occurs in monotypic tree stands in sandy soils.

4a. Northern Catalpa dominant in the canopy……go to 5

4b. Northern Catalpa not dominant in the canopy……go to 7

5. **Catalpa speciosa Forest Alliance**

This is a refuge specific alliance to address populations of Catalpa found in shelter belts. These forests are dominated by Catalpa but often contain red cedars cottonwood and other mixed trees. It also tends to occur in sandy soils on the edges of roads…….go to 6

6. **Catalpa speciosa Forest**

This is a refuge specific association to address populations of Catalpa found in shelter belts. The forest occurs in mixed or monotypic tree stands in sandy soil.

7a. Kentucky coffee tree dominant in the canopy……..go to 8

7b. Kentucky coffee tree not dominant in the canopy……go to 10

8. **Gymnocladus dioica Forest Alliance**

This is a refuge specific alliance to address populations of Kentucky coffee tree found in shelter belts. This alliance is monotypic and occurs in sandy soils……go to 9

9. **Gymnocladus dioica Forest**

This is a refuge specific association to address populations of Kentucky coffee tree found in shelter belts. This is a planted tree that is found in a few small stands on the refuge.

10. Red Cedar dominant in the canopy……go to 11

10. Red Cedar not dominant in the canopy…… go to 13

11. **Juniperus virginiana Semi-natural Forest Alliance**

Examples of this semi-natural eastern red-cedar forest alliance are expected to be found in locally disturbed areas. Forests in this alliance are strongly dominated by Juniperus virginiana var. virginiana on usually high pH, fire-suppressed sites or old fields. This alliance is most common in old fields and pastures, successional cleared land, and other various disturbed areas, especially on calcareous rocks. The growth of Juniperus virginiana var. virginiana may be very dense, and the stature may be rather low. Other species that may occur in the canopy of Tennessee stands include Carya alba, Carya ovata, Cercis canadensis, and Pinus virginiana. Various oaks (including Quercus coccinea, Quercus falcata, and Quercus phellos) also may be present. The midstory is typically sparse, with canopy species as well as Cornus florida, Ilex opaca, Liquidambar styraciflua, and Prunus serotina var. serotina. Frangula caroliniana may occur in several strata. Herb distribution is patchy, and typical species include Asplenium platyneuron, Chasmanthium laxum, Eupatorium spp., Polystichum acrostichoides, and Carex spp. In the central and upper midwestern United States, stands of semi-natural vegetation dominated by Juniperus virginiana var. virginiana typically occur in old fields and other disturbed places. The vegetation may vary in structure from open-canopy woodland (particularly as it invades herbaceous old fields) to dense, closed-canopy forest. Rhus typhina may be an associate……go to 11

12. **Juniperus virginiana Semi-natural Forest**

There is no current written description for this association in the NVCS system. This forest system tends to occur in tree rows or near areas where red cedar makes up the secondary story of a tree plantation. It often occurs as a mixture with other species of tree but it can occur in monotypic stands. Often the red cedar is mixed with cottonwood. It grows in dryer sandier areas.

13a. Cottonwood dominant in the canopy…….go to 14

13b. Cottonwood is not dominant in the canopy……..go to 16

14. **Populus deltoides Temporarily Flooded Forest Alliance**

This alliance, found throughout the central midwestern and southeastern United States, contains riverfront floodplain forests. The tree canopy is tall (to 30 m) and dominated by Populus deltoides and Salix nigra, although Fraxinus pennsylvanica, Acer negundo, Acer rubrum, Acer saccharinum, Platanus occidentalis, and Ulmus americana are also commonly encountered in various parts of this alliance's range. Tree diversity is limited due to the dynamics of flooding and deposition/scouring of sediments. The shrub layer is often sparse, but species such as Salix exigua, Carpinus caroliniana, Lindera benzoin, Cornus drummondii and, in the Southeast, Ilex vomitoria, Ilex opaca var. opaca, and Forestiera acuminata can be found. Herbaceous growth can be thick and lush but is often patchy and sparse due to frequent inundation. Herbaceous species found throughout the range of this alliance are not well known, but in parts of the range, species can include Carex spp., Leersia oryzoides, Bidens spp., Asteraceae spp., Eragrostis hypnoides, Lipocarpha micrantha, Rumex maritimus, Potentilla paradoxa, and, more commonly in the Southeast, Leptochloa panicea ssp. mucronata (= Leptochloa mucronata) and Mikania scandens.

Stands are found primarily along riverfronts, where they develop on bare, moist soil on newly made sand bars, front-land ridges, and well-drained flats. Soils are formed in alluvium, are deep, medium-textured, and with adequate or excessive moisture available for vegetation during the growing season. This alliance can also be found on abandoned fields and well-drained ridges in the first bottoms…….go to 15

15. **Populus deltoides - Salix nigra Forest**

This cottonwood - black willow forest is characteristic of the fronts and banks of most major rivers and streams throughout the Central Forest Region, extending into the northern forest particularly within the Mississippi, Ohio, and Missouri River systems. It develops on bare, moist soil on recently formed sand bars, front-land ridges, and well-drained flats, along with Salix interior, Eragrostis hypnoides, Leptochloa panicea ssp. brachiata (= Leptochloa filiformis), Lipocarpha micrantha (= Hemicarpha micrantha), Rumex maritimus, Potentilla paradoxa, and Bidens spp. This natural community can also be found on abandoned fields and well-drained

ridges in the first bottoms. Soils are formed in alluvium, are deep, medium-textured, and with adequate or excessive moisture available for vegetation during the growing season. The tree canopy is tall (to 30 m) and dominated by Populus deltoides and Salix nigra, although Fraxinus pennsylvanica, Acer saccharinum, Acer negundo, Platanus occidentalis, and Ulmus americana are also commonly encountered. Tree diversity is limited due to the dynamics of flooding and resultant deposition and scouring of sediments. The subcanopy is almost exclusively Salix nigra. The shrub layer is conspicuously absent in many parts of the range. Herbaceous growth can be thick and lush but is often patchy and sparse due to frequent inundation. Species most often encountered in the ground layer include Carex spp., Leersia oryzoides, Bidens spp., and Asteraceae spp.

16a. Black or Honey Locust dominant in the canopy…….go to 17

16b. Green Ash dominated in the canopy…….go to 19

17. **Robinia pseudoacacia /Gleditsia triacanthos Forest Alliance**

This is a refuge specific alliance to address populations of Black and Honey Locust found in stands on the Refuge

This alliance includes forests in which Robinia pseudoacacia occur in pure stands and areas where Gleditsia triacanthos is also present although not in large quantities. The areas are usually less than 40 acres and the associated species varying widely depending on geography and habitat. Locust has become naturalized in many areas throughout the united states ……..go to 18

18. **Robinia pseudoacacia /Gleditsia triacanthos Forest**

This is a refuge specific association to address populations of Black and Honey Locust found in stands on the Refuge. These invasive populations are found in sandy soils in both monotypic tree stands and mixed tree stands found on the refuge. Honey Locust can occur as solitary trees in a prairie environment

19. **Fraxinus pennsylvanica Forest Alliance**

This is a refuge specific alliance to address mixed tree stands where green ash is dominant. This tree also occurs in many mixed tree stands in small quantities. This Tree occur in a wide range of soils, moisture and pH…….go to 20

20. **Fraxinus pennsylvanica Forest**

This is a refuge specific association to address mixed stands dominated by green ash. With a few exceptions this tree often only makes up about 10% of a tree canopy except in areas where it has not been shaded out by larger trees.

Woodland

1a. Box elder dominant in the canopy…….go to 2

1b. Box Elder not dominant in the canopy…….go to 4

2. **Acer Negundo Woodland Alliance**

This is a refuge specific alliance to address a small population of box elder found only in the southern part of the refuge. These trees occur in a small clump in drier sandy areas. This tree is often grouped with other types trees in mixed stands……got to 3

3. **Acer Negundo Woodland**

This is a refuge specific association to address a small population of box elder found on the refuge. These woodlands are found near tree groves in in small patches in grasslands.

4a. Hackberry is dominant in the canopy……go to 5

4b. Hackberry is not dominant in the canopy……go to 7

5. **Celtis occidentalis Woodland Alliance**

This is a refuge specific alliance to address populations of Hackberry found in small populations found throughout the Refuge. These trees occur in small clumps or singularly throughout the refuge in drier sandy areas……..go to 6

6. **Celtis occidentalis Woodland**

This is a refuge specific association to address populations of Hackberry found in small populations found throughout the Refuge. It often mixes with other tree species in larger groves. These woodlands are found near tree groves in in small patches in grasslands. This tree like alluvial soil and a wide range of pH, full sun and wind.

7a. Russian olive is dominant in the canopy……..go to 8

7b. Russian olive is not dominant in the canopy…….go to 10

8. **Elaeagnus angustifolia Woodland Alliance**

This is a refuge specific alliance to address populations found in small to moderate sized stands on the Refuge. This invasive plant occurs in moist areas and around sources of water. It is sometimes mixed with other wetland trees like Salt Cedar and Cottonwood.
……..go to 9

9. **Elaeagnus angustifolia Woodland**

This is a refuge specific association to address populations found in small to moderate sized stands on the Refuge. This association occurs throughout the refuge in mixed stands or in groups of solitary trees in wet meadow areas.

10a. Mulberry is dominant in the canopy……..go to 11

10b. Mulberry is not dominant in the canopy…….go to 13

11. **Morus rubra Woodland Alliance**

This is a refuge specific alliance to address populations of Mulberry found in small populations found throughout the Refuge. These trees occur in small clumps or singularly throughout the refuge in drier sandy areas. They also occur in small amounts in many mixed tree stands ……...go to 12

12. **Morus rubra Woodland**

This is a refuge specific association to address populations of Mulberry found in small populations found throughout the Refuge. These woodlands are found near tree groves in in small patches in grasslands.

13a. Elm is dominant in the canopy…….go to 14

13b. Osage orange is not dominant in the canopy……go to 19

14a. American elm is dominant in the canopy……go to 15

14b. Siberian Elm is dominant in the canopy…….go to 17

15. **Ulmus Americana Woodland Alliance**

This is a refuge specific alliance to address populations of American elm found in small populations found throughout the Refuge. These trees occur in small clumps or singularly throughout the refuge in drier sandy areas…….go to 16

16. **Ulmus Americana Woodland**

This is a refuge specific association to address populations of American elm found in small populations found throughout the Refuge. These woodlands are found near tree groves in in small patches in grasslands.

17. **Ulmus pumila Woodland Alliance**

This is a refuge specific alliance to address populations of Siberian elm found in monotypic stands on the Refuge. These tree groves sometimes occur in tree stands abutting other invasive tree on the refuge. These trees grow in sandy soils close together……go to 18

18. **Ulmus pumila Woodland**

This is a refuge specific association to address populations of Siberian elm found in stands on the Refuge. This plant is invasive and often occurs in pure stands throughout the refuge.

19. **Maclura pomifera Woodland Alliance**

This is a refuge specific association to address populations of planted Osage orange located in tree stands on the refuge. The areas where these trees are found are areas that were formally used in agriculture…….go to 20

20. **Maclura pomifera Woodland**

This is a refuge specific association to address populations of planted Osage orange located in Tree stands on the refuge. Many of these stands are surrounded by other trees like red cedar mulberry, or cotton wood that moved into the areas after the Osage orange was planted.

Shrubland

1a. Dogwood is dominant or co-dominant…….go to 2

1b. Dogwood not dominant……..go to 4

2. **Cornus drummondii Shrubland Alliance**

In the central Great Plains and western tallgrass regions of the United States, stands of this alliance occur on level to moderate, well-drained slopes of uplands, usually along the borders of upland woods, but also in grassland ravines. In the upper southeastern states, this alliance typically occupies disturbed or successional uplands over limestones, dolomites, or other neutral to basic substrates. The vegetation consists of thickets or patches of shrubs 2-3 m tall. Cornus drummondii and Rhus glabra are usually the dominant species, although Prunus americana, Prunus angustifolia, Prunus mexicana, Rhus aromatica, or Symphoricarpos orbiculatus may dominate in places. In the midwestern states, Corylus americana may be a component. Where shrub cover is dense, vines may be present. In the southeastern states, these may include Berchemia scandens, Toxicodendron radicans, and Parthenocissus quinquefolia. In the midwestern states, Celastrus scandens and Parthenocissus vitacea may assume this role. Under the dense canopy, the herbaceous layer may be sparse, consisting of various native grasses and forbs, but also exotic species such as Lespedeza cuneata, Poa pratensis, and/or Nepeta cataria. In open stands, the herbaceous layer is more dense and consists of species characteristic of tallgrass and mixedgrass prairie, or in the southeastern states, species which are common to perennial limestone glade-margin associations……go to 3

3. **Cornus drummondii-(Rhus glabra, Prunus spp.) Shrubland**

Found on level to moderate, well-drained slopes of uplands, usually along the borders of upland woods, but also in grassland ravines. The vegetation consists of bands or patches of shrubs 2-3 m tall. Rhus glabra and Cornus drummondii are usually the dominant species, although Prunus americana, Symphoricarpos orbiculatus, or Rhus aromatica may dominate in places. Under a dense canopy of shrubs the herbaceous layer may be sparse. In more open stands the herbaceous layer is denser and consists of tall grass prairie species. Many stands may have originated through human disturbance and management so this is considered a semi-natural vegetation type.

4a. Plum is dominant……..go to 5

4b. Plum is not dominant……..go to 7

5. **Prunus spp. Shrubland Alliance**

This is a refuge specific alliance that combines all the species of plum on the refuge. This alliance occurs in scattered locations at low to mid elevations of the western U.S. Soils are usually well-developed, older, and well-drained, formed in shallow to deep alluvial deposits. These soils have higher fertility and afford good rooting depth. Textures range from silt to sandy loams, often becoming skeletal at depth. Prunus virginiana can tolerate weakly saline soils, but is intolerant of poor drainage and prolonged flooding. This alliance is characterized by a tall, dense layer of shrubs which can become colonial thickets. In the absence of disturbance, this species can form dense, monotypic thickets. It also occurs on sand dunes, old fields, disturbed areas, and pastures……..go to 6

6. **Prunus spp. Shrubland**

This is a refuge specific association that combines all the species of plum on the refuge. The elevation range is 680 to 2652 m (2234-8700 feet). This association grows at the interface between larger riparian areas and the adjacent upland and occurs as small dense thickets, narrow bands, or irregular patches. Exotic species Bromus inermis, Cirsium arvense, Poa pratensis, and Bromus tectorum are common on disturbed sites. It occurs in most grassland areas on the refuge.

7a. Fragrant sumac is dominant……go to 8

7b. Fragrant sumac is not dominant……go to 10

8. **Rhus aromatica Shrubland Alliance**

This is an alliance to address small uniform stands of smooth sumac found in the refuge. It occurs in small dense patches in grassland areas.
.....go to 9

9. **Rhus aromatica Shrubland**

This is an association to address small uniform stands of smooth sumac found in the refuge. This plant grows in small dense patches in grassland areas. There is one very dense are of this plant and many small isolated areas.

10a. Sandbar Willow dominant……go to 11

10b. Tamarisk is dominant……go to 13

11. **Salix (exigua, interior) Temporarily Flooded Shrubland Alliance**

Plant associations within this temporarily flooded shrubland alliance are located on floodplains and gravel bars between 780 and 2700 m (2560-9100 feet) elevation in the western U.S., and at lower elevations (to below 100 m) in the midwestern and southeastern U.S. Stands may be dominated either by Salix exigua (in the West) or Salix interior (in the Midwest and East). Both species and intermediates may occur in stands in the region where the range of the two species overlap. These shrublands are found on open sandbars without tree canopy shading, on larger, well-developed drainages and along larger sandy rivers, or on coarser-textured substrates. They are associated with annual flooding and inundation and will grow well into the channel, where it is flooded, even in drier years. Even though flooding is frequent, surface water is not present for much of the growing season, and the water table is well below the surface. Some stands form large, wide stands on mid-channel islands on larger rivers, or narrow stringer bands on small, rocky tributaries. Stream reaches range widely from moderately sinuous and moderate-gradient reaches to broad, meandering rivers with wide floodplains or broad, braided channels. Many stands also occur within highly entrenched or eroding gullies. The canopy is dominated by a tall, 2- to 5-m, broad-leaved deciduous shrub that is typically many-branched with continuous cover of 60-100%. The herbaceous stratum has sparse to moderate cover including a variety of pioneering species. This alliance represents an early-seral, primary successional stage on newly deposited sediments that may persist under a regime of repeated fluvial disturbance. Salix exigua and Salix interior are highly adapted to most forms of disturbance. Both species are prolific sprouters and will reestablish themselves on sites dominated by other disturbance-associated species, e.g., Glycyrrhiza lepidota and Pascopyrum smithii (= Agropyron smithii). Associations in this shrubland alliance are common and widespread.

Shrublands dominated solely by Salix exigua (sensu stricto) extend from the Pacific Northwest and California east into the Rocky Mountains and onto the Great Plains. Stands of possibly mixed or ambiguous composition may occur from the northern Great Plains south to the Colorado plains, possibly extending into northeastern New Mexico and the western portions of the Dakotas, Nebraska, Kansas, and Oklahoma. Examples dominated by Salix interior occur in the Midwest in Iowa, Illinois, Indiana, Ohio, and the eastern portions of North Dakota, South Dakota, Nebraska, and Kansas. They also extend into Arkansas, Tennessee, Kentucky, Texas, and eastern Oklahoma, and possibly in Pennsylvania and West Virginia, as well as in Manitoba and other provinces of Canada. In western Oklahoma and throughout the Ozarks the

associations are local along major streams. In the West, adjacent upland plains communities include agricultural fields and rolling hills of Artemisia filifolia, xeric tallgrass prairies, and Bouteloua gracilis shortgrass prairies. In the steep canyons of the foothills, upslope vegetation includes Pseudotsuga menziesii and Pinus ponderosa forests, Pinus edulis and Juniperus spp. woodlands, oak, sagebrush, and greasewood scrub. In the lower montane, upslope vegetation includes Pinus contorta and Populus tremuloides forests…….go to 12

12. **Salix exigua / Mesic Graminoids Shrubland**

This riparian association is found primarily in the central Great Plains but also occurs in parts of the Rocky Mountains and Intermountain semi-desert regions. It generally occurs along backwater channels and other perennially wet but less scoured sites such as floodplain swales and irrigation ditches. The vegetation is characterized by the dominance of Salix exigua in a moderately dense tall-shrub canopy with a dense herbaceous layer dominated by graminoids. Other common shrubs include saplings of Populus deltoides or Salix amygdaloides, Salix eriocephala, Salix lutea, and Amorpha fruticosa. Tall perennial grasses can appear to codominate the stand when Spartina pectinata, Panicum virgatum or other tall grasses are present. Other mesic graminoids, such as Carex spp., Eleocharis spp., Juncus spp., Pascopyrum smithii, Schoenoplectus pungens (= Scirpus pungens), and Sphenopholis obtusata, may be present. Common forb species include Bidens spp., Lobelia siphilitica, Lycopus americanus, Lythrum alatum, Polygonum spp., and Xanthium strumarium. Diagnostic features of this association include the nearly pure stands of Salix exigua shrubs, with a dense herbaceous layer of at least 30% cover of mesic graminoids.

13. **Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance**

This alliance is composed of shrublands which form moderately dense to dense thickets on banks of larger streams, rivers and playas across the western Great Plains, interior and southwestern U.S., and northern Mexico. Stands are dominated by introduced species of Tamarix, including Tamarix ramosissima, Tamarix chinensis, Tamarix gallica, and Tamarix parviflora. Introduced from the Mediterranean, Tamarix spp. have become naturalized in various sites, including salt flats, springs, and especially along streams and regulated rivers, often replacing Salix or Prosopis spp. shrublands or other native vegetation. A remnant herbaceous layer may be present, depending on the age and density of the shrub layer. These species have become a critical nuisance along most large rivers in the semi-arid western U.S. Because of the difficulty to remove, Tamarix spp. may have irreversibly changed the vegetation along many rivers……go to 14

14. **Tamarix spp. Semi-natural Temporarily Flooded Shrubland**

There is no current written description for this association in the NVCS system. This invasive Shrubland can be found along creeks and other areas with large amounts of water in dense numbers but it can occur in moist soil where it occurs in a less dense scattered pattern.

Herbaceous

1a. Vegetation is planted in lines and is made up of Agricultural plants……go to 2

1a. Vegetation is not planted in lines and is not dominated by agricultural plants……go to 4

2. **Agriculture Vegetation Alliance**

This alliance represents all the Agriculture fields in use on the refuge. These areas are plowed and seeded on a regular basis. Some areas that have been reseeded but still function like an agricultural field are included in this category……go to 3

3. **Agriculture Vegetation**

This association represents all the Agriculture fields in use on the refuge they occur in areas that were formally grasslands or wet meadows.

4a. Big bluestem is dominant……go to 5

4b. Big bluestem is not dominant……go to 10

5a. Big bluestem is dominant with bluejoint and switchgrass……go to 6

5b. Big Bluestem is dominant with Indiangrass……go to 8

6. **Andropogon gerardii - (Calamagrostis canadensis, Panicum virgatum) Herbaceous Alliance**

This alliance, found in central North America, is made up of mesic to wet-mesic tall grasslands. Stands of this widespread alliance occur most frequently on sand to silt loam soils. Some are found on clay loams or silty clays. The sites are typically level to gently sloping, and those with heavier soils often have standing water present in the spring or after heavy rains. Most stands are in the glaciated Midwest and occur on glacial till, outwash, drift, or glacial lakeplains. Fires were a common occurrence in stands of this alliance before effective fire-suppression activities. In the prolonged absence of fire, woody species usually invade and can become abundant. The dominant lifeforms in stands of this alliance are tall grasses, although forbs can be abundant as well. Trees and shrubs can occur as scattered individuals or clumps. Vegetation tends to be dense and between 1.5 and 2 m tall. The dominant species across the range of this alliance is Andropogon gerardii. Other species that are common to abundant throughout the alliance's range are Calamagrostis canadensis, Carex spp., Panicum virgatum, Sorghastrum nutans, and Spartina pectinata. Muhlenbergia richardsonis may be diagnostic of this alliance in the northeastern Great Plains, and Pascopyrum smithii is common in the western portion of this alliance's range. Elymus canadensis is abundant in Wisconsin. Schizachyrium scoparium can be found on sites subject to seasonal drought. Forbs are abundant, especially farther east in this alliance's range. Among these forbs are Asteraceae spp., Helianthus grosseserratus, Lysimachia quadrifolia, Pycnanthemum virginianum, Ratibida columnifera, Ratibida pinnata, Thalictrum dasycarpum, and Zizia aurea…….go to 7

7. **Andropogon gerardii - Panicum virgatum - Helianthus grosseserratus Herbaceous Vegetation**

This wet-mesic tallgrass prairie community is found widely throughout the central midwestern United States. Stands typically occur in narrow draws of headwaters of small streams, depressions of terraces (sometimes uplands), and on floodplains of larger streams and rivers. The loamy soils are somewhat poorly drained and deep (100 cm or more). Standing surface water may be present for short periods in the winter and spring or after heavy rains. Fire was common in this community. There is a single layer of dominant graminoids intermixed with abundant forbs. Andropogon gerardii and Spartina pectinata can exceed 2 m in height in this wet-mesic community. Panicum virgatum is usually somewhat shorter but still greater than 1 m tall. Other typical plants found in this community in Missouri are Juncus interior, Tripsacum dactyloides, Helianthus grosseserratus, Potentilla simplex, Eryngium yuccifolium, and Carex bicknellii. Calamagrostis canadensis is more common northward. Species diversity does not tend to be as high as in more mesic grassland communities. Woody species can become more abundant in the absence of fire.

8. **Andropogon gerardii - (Sorghastrum nutans) Herbaceous Alliance**

This alliance is a very widespread mesic tallgrass prairie, which occurs in central North America. Stands of this alliance occur on flat to rolling topography. In the western and southern U.S., stands are found on lower slopes and valleys that receive extra moisture. On the western plains, the alliance can be found in areas with gravelly soil where water infiltrates below the surface but is held by an impermeable subsurface layer. Floodplain and toeslope soils are deep and fine-textured, whereas the foothills soils are coarse-textured, often with cobble-sized rocks. In the northwestern plains, this alliance in found on lower slopes of hills, creeks and creek terraces. Soils are generally finer-textured (clay loams). In other parts of this alliance's range, stands can be found on many topographic positions. Soils are generally fertile, deep, slightly acidic, and moderately to well-drained. In glacial lakeplains near the Great Lakes, soils tend to be more poorly drained. Soils moisture is generally mesic, although it can vary from dry-mesic to wet-mesic. Soil texture can range from clay loams to sands.

Most communities have moderately dense to dense vegetation dominated by graminoids 1-2 m tall. Andropogon gerardii is dominant across this alliance's range. Other abundant species include Bouteloua curtipendula, Pascopyrum smithii (in the western portions of this alliance's range), Schizachyrium scoparium, Sorghastrum nutans (in the center and east), Sporobolus heterolepis (in the Great Plains), and Hesperostipa spartea (= Stipa spartea) (in the northern Great Plains). In Montana, Festuca idahoensis (at its eastern range limits) is codominant in an association in this alliance. Forbs are abundant in stands of this alliance, especially in the more humid East. Among these are Aletris farinosa (in the East), Asteraceae spp., Echinacea pallida, Helianthus grosseserratus, Liatris pycnostachya, Phlox pilosa, Ratibida pinnata, Silphium laciniatum (in the center), and Solidago spp. Galium boreale and Oxalis sp. are more common in northern tallgrass prairies than in southern. Trees and tall shrubs are infrequent in high-quality stands, especially in the Great Plains. Among those that may be found are scattered

Symphoricarpos occidentalis (in the northern Great Plains), Rhus spp., and Quercus macrocarpa (in the central and eastern portions of this alliance's range).

In the far western extent, vegetation in this alliance is a relict true prairie found along the eastern foothills and floodplains of the Front Range of the Rocky Mountains. Andropogon gerardii is the major diagnostic species, as well as Sorghastrum nutans, Panicum virgatum, Schizachyrium scoparium, Sporobolus heterolepis, the other common tallgrass prairie species. Bouteloua curtipendula and Pascopyrum smithii are also common grasses. The alliance is found in mesic areas along the Colorado Front Range. Landform position and soil texture dictate potential sites, as precipitation is generally not adequate to support stands of this alliance. In localized areas, hydrological processes of the site enhance the soil moisture. Along the Front Range, "relict" true prairie is found along the foothills in parks and on slopes below Pinus ponderosa woodlands. Soils are coarse-textured, and runoff and seeps enhance soil moisture. The alliance is also found in floodplains adjacent to streams where the water table is within reach for plant roots……go to 9

9. **Andropogon gerardii - Sorghastrum nutans Western Great Plains Herbaceous Vegetation**

This big bluestem prairie is a tallgrass, wet meadow found in the west-central Great Plains of the United States. Stands occur in riparian areas and low-lying swales on the more western plains and are less riparian-dependent in the central plains as the amount of annual rainfall increases. This mesic prairie association is able to survive along the foothills because the cobbly soils are able to retain adequate moisture. The vegetation is dominated by tall grasses, particularly Andropogon gerardii and Sorghastrum nutans. Other grasses include Panicum virgatum, Pascopyrum smithii and Sporobolus cryptandrus. Forbs may include Desmanthus illinoensis and Glycyrrhiza lepidota.

10a. Sand bluestem is dominant

10b. Sand bluestem is not dominant

11. **Andropogon hallii Herbaceous Alliance**

This alliance includes herbaceous vegetation with Andropogon hallii, occurring in the Great Plains from the United States-Canada border south to Texas. It is dominated by tall and midgrass species, with shortgrass species becoming important in the western portion of its range. Andropogon hallii is usually dominant or codominant. Calamovilfa longifolia is present to codominant in most stands south of the South Dakota-Nebraska border. Hesperostipa comata (= Stipa comata), Koeleria macrantha, Schizachyrium scoparium, Bouteloua gracilis, Bouteloua hirsuta, Eragrostis trichodes, Pascopyrum smithii, and Sporobolus cryptandrus are typical grasses in stands of this alliance. Upland sedges are also very common, especially Carex filifolia, Carex inops ssp. heliophila, and Carex duriuscula (= Carex eleocharis). Although graminoids are overwhelmingly dominant, several species of forbs can be found in many stands of this alliance. Some of the more common forbs are Ambrosia psilostachya, Psoralidium spp., Ipomoea leptophylla, Liatris punctata, and Tradescantia occidentalis. There may be widely scattered low

shrubs, including Rosa woodsii, Prunus pumila var. besseyi, and Yucca glauca. In west Texas common associates on deep sands include Panicum havardii, Sporobolus giganteus, and Calamovilfa gigantea. Stands of this alliance occur on sand deposits, usually on gentle to steep slopes but sometimes on flat ground. The soils are sand, loamy sand, or sandy loam. They can be poorly to moderately well-developed. There is little runoff or evaporation because moisture quickly sinks into the coarse soil. Soil near the surface is consequently dry throughout much of the year, but moisture is present further down, favoring deep-rooting species such as Andropogon hallii and Calamovilfa longifolia. Wind sometimes scours sand and vegetation from small areas, creating blowouts. These bare spots are initially colonized by species that are uncommon in this alliance, such as Muhlenbergia pungens and Redfieldia flexuosa. Eventually, these blowouts succeed to one of the communities in the Andropogon hallii Herbaceous Alliance (A.1193). These grasslands occur on semi-stabilized quartz sand dunes in eastern Trans-Pecos Texas, where they form landscape mosaics with Quercus havardii shrublands, wetland dune swales, and sparsely vegetated dunes. The rare plant, Penstemon haydenii, an endemic to dune blowouts in the sandhills of Nebraska, may be endangered by the decline in habitat because of fire suppression and low to moderate stocking rates (Harrison 1980)……go to 12

12. **Andropogon hallii-Calamovilfa longifolia Herbaceous Vegetation**

This sand prairie community is found in the northern and central Great Plains of the United States and Canada. Stands are found on sandy deposits, usually on gentle to moderate slopes, ranging from stabilized rolling to choppy sand dunes. The soil is sand, loamy sand, or sandy loam, often erodible, and somewhat poorly developed. This community is dominated by moderately widely spaced mid to tall grasses. The most abundant species are Andropogon hallii and Calamovilfa longifolia. Other graminoids that may be found in this community include Bouteloua gracilis, Bouteloua hirsuta, Carex duriuscula, Carex filifolia, Carex inops ssp. heliophila, Cyperus schweinitzii, Eragrostis trichodes, Hesperostipa comata (= Stipa comata), Koeleria macrantha, Muhlenbergia pungens, Redfieldia flexuosa, and Schizachyrium scoparium. Forbs and shrubs are a minor component of the total vegetation. Characteristic forbs include Chenopodium subglabrum, Chamaesyce serpyllifolia, Helianthus pauciflorus, Helianthus petiolaris, Lappula occidentalis var. occidentalis, Liatris punctata, Lithospermum incisum, Lygodesmia juncea, Monarda punctata, Oenothera rhombipetala, Penstemon haydenii (in Nebraska), and Psoralidium lanceolatum. Artemisia frigida and Yucca glauca are the most common shrubs, especially on wind-blown dune crests and choppy slopes in Nebraska sandhills. In southeastern North Dakota, a subtype containing tallgrass species may be distinct; species include Andropogon gerardii, Symphyotrichum ericoides (= Aster ericoides), Lithospermum canescens, Solidago nemoralis, and Sporobolus heterolepis.

13a. Little Bluestem is dominant……go to 14

13b. Little Bluestem is not dominant……go to 16

14. **Schizachyrium scoparium - Bouteloua curtipendula Herbaceous Alliance**

This alliance is mainly in the Great Plains but extends eastward to the Mississippi River and even beyond on dry sites. Across its range, the vegetation is dominated by mid grasses. Communities within this alliance are most commonly found on slopes but can occur on level ground. Loam and silt soils appear to be the most common; however, in the southwest of this alliance's range, some communities are predominantly on sandy soils. Communities in the central and western portions of this alliance's range usually occur on medium to deep soils. Communities in the eastern portion of this alliance's range are found almost exclusively on steep south- or west-facing slopes. These slopes have thinner soils, greater insolation, and greater runoff than surrounding areas. These factors inhibit the growth of taller grasses and woody species and allow the midgrass communities to be maintained. Most of these sites are small.

The vegetation cover can be moderately sparse to dense. Tall grasses and short grasses contribute substantially to the vegetation cover in most communities. The proportions of these two lifeforms are typically negatively correlated with each other and vary with the specific community and site. The tall grasses are more prevalent on sandier soils and on moderate or gentle lower slopes. The short grasses tend to be more common on flat uplands or steep slopes with heavier soils. The dominant species are the nominal species, Schizachyrium scoparium and Bouteloua curtipendula. Bouteloua gracilis and Bouteloua hirsuta are common associates across this alliance's range. Other graminoids that are present to codominant are Aristida purpurea, Andropogon gerardii, Andropogon hallii (on sandier soils), Buchloe dactyloides (in the south and west of this alliance's range), Calamovilfa longifolia (on sandier soils), Carex duriuscula (= Carex eleocharis), Carex inops ssp. heliophila, and Carex filifolia (all three Carices in the north), Koeleria macrantha, Muhlenbergia cuspidata, Pascopyrum smithii, Pseudoroegneria spicata (in the northwest), Sporobolus cryptandrus, Sporobolus compositus var. compositus (in the south), Sporobolus heterolepis (in the east), Hesperostipa spartea (= Stipa spartea), and Hesperostipa comata (= Stipa comata) (in the north). There are a great number of forbs that occur in communities of this alliance, although they do not make up a large part of the herbaceous canopy. Amorpha canescens, Symphyotrichum oblongifolium (= Aster oblongifolius), Symphyotrichum ericoides (= Aster ericoides), Ambrosia psilostachya, Dalea purpurea, Echinacea angustifolia, Gaura coccinea, Liatris punctata, Lygodesmia juncea, Ratibida columnifera, and Sphaeralcea coccinea are found in many communities in this alliance. Shrubs are not abundant, but Symphoricarpos occidentalis, Yucca glauca, Artemisia frigida, and Rosa spp. may be scattered among the herbaceous species……..go to 15

15. **Schizachyrium scoparium - Bouteloua curtipendula Western Great Plains Herbaceous Vegetation**

This little bluestem grassland community is found in the southwestern Great Plains of the United States. Stands occur on shallow sandy or rocky soil, usually on level or gently sloping terrain, although it may also occur on moderate slopes. The vegetation of this community is dominated by mid grasses with tall and short grasses present to abundant. The vegetation cover is moderate to dense. Schizachyrium scoparium and Bouteloua curtipendula are the dominant species. Andropogon hallii, Bouteloua gracilis, Bouteloua hirsuta, Koeleria macrantha,

Panicum virgatum, Sorghastrum nutans, Hesperostipa neomexicana (= Stipa neomexicana), Sporobolus compositus var. compositus, and Sporobolus cryptandrus are common grasses of this community. Forbs do not make up a large amount of the canopy, but Eriogonum spp. and Dalea purpurea are typically in stands of this community. Woody plants, such as the short shrubs Gutierrezia sarothrae and Yucca glauca, are uncommon but usually present.

16a. Switch grass and/or Indian grass are the only dominant grass (es) present…….go to 17

16b. Other herbaceous plants are dominant……..go to 21

17. **Panicum virgatum Alliance**

This is a Quivira Alliance that incorporates all areas dominated by switchgrass on the refuge. These areas on the refuge only contain secondary grasses due to current habitat conditions. They are often next to other sections that contain dominant grass species……go to 18

18a. Switchgrass alone is dominant……go to 19

18b. Switchgrass and Indiangrass are codominant…….got to 20

19. **Panicum virgatum Herbaceous Vegetation**

This is a Quivira association that incorporates all areas dominated solely by switchgrass on the refuge. Often these areas are disturbed and switchgrass is the only non-forb located in the polygon.

20. **Panicum virgatum- Sorghastrum nutans Herbaceous Vegetation**

This is a Quivira association that incorporates all areas dominated solely by switchgrass and Indiangrass on the refuge. These areas are missing a primary grass and only contain secondary grasses. Despite this areas are often thickly vegetated.

21a. Cheat grass is dominant……..go to 22

21b. Cheatgrass is not dominant……..go to 24

22. Bromus tectorm Semi-natural Herbaceous Alliance

Although this is a listed NVCS Alliance, Nature Serve has not yet written a description for this alliance. This alliance is dominated by cheatgrass and there is no evidence of other plant communities within the area. This plant likes to occur in disturbed or formally disturbed sites. It also grows in areas that other plants don't grow well like shaded bushes and trees
…….Go to 23

23. Bromus tectorum Semi-natural Herbaceous Vegetation

Although this is a listed NVCS Association, Nature Serve has not yet written a description for this association. This vegetation type thrives in areas that have been disturbed by natural or human disturbance. These areas can also have a large numbers of forbs present.

24a. Saltgrass is dominant……go to 25

24b. Saltgrass is not dominant……..go to 27

25. **Distichlis spicata - (Hordeum jubatum) Temporarily Flooded Herbaceous Alliance**

This alliance occurs in the Great Plains and western United States. This description is based on those communities found in the Great Plains. Dominant vegetation is a mixture of short and mid grasses and can have moderately sparse to dense cover. Vegetation height and cover and species diversity tend to vary inversely with salinity. Distichlis spicata is the most abundant species in stands across the range of this alliance. Other species found in the Great Plains include Grindelia squarrosa (in the northern portion of this alliance's range), Hordeum jubatum, Iva annua, Bassia scoparia (= Kochia scoparia), Pascopyrum smithii (on less saline stands), Poa arida, Puccinellia nuttalliana (in the north), Salicornia rubra (on more saline stands), Schoenoplectus maritimus (= Scirpus maritimus), Sporobolus airoides, and Suaeda calceoliformis (on more saline stands). Widely scattered low shrubs, especially Atriplex patula and Sarcobatus vermiculatus, can be found on sites in the western and central Great Plains. Trees are not found on stands of this alliance.

Stands of this alliance are found in depressions and along the margins of saline lakes and ponds. Most of the stands are flooded or saturated for a few weeks in the spring and after heavy rains; some have water present for most of the growing season. The soils range from sand to clay and from moderately well-drained to poorly drained. Most are deep and moderately to strongly saline. Stands that have good drainage in the surface soils usually have a deeper impermeable or slowly permeable layer that allows retention of water. Fires which spread from upland prairies may have moved through the more dense stands, but many stands did not have sufficient vegetation to support fires……..go to 26

26. **Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides) Herbaceous Vegetation**

This saline wetland community is found in the central and southern Great Plains of the United States, on level to gently sloping stream terraces, foot slopes, and shallow depressions that are flooded for a few weeks in the spring. Soils are fine sand to clay, well to moderately poorly drained, and usually deep. The soils are moderately to strongly saline and tend to have alkaline pH. Dominant vegetation is halophytic short and mid grasses, which are moderately dense and tall on less saline sites and moderately sparse and shorter on more saline sites. Species diversity also increases on less saline sites. Distichlis spicata is typically one of the most abundant species. Iva annua, Hordeum jubatum, Poa arida, and Sporobolus airoides can be present to codominant. Other common species include Leptochloa fusca ssp. fascicularis (= Leptochloa fascicularis), Pascopyrum smithii (especially on less saline sites), Suaeda calceoliformis, and

Salicornia rubra. Low shrubs, notably Atriplex patula and Sarcobatus vermiculatus, may be scattered across this community.

27a. Spike rush is dominant……..go to 28

27b. Spike rush is not dominant……go to 30

28. **Eleocharis palustris Temporarily Flooded Herbaceous Alliance**

This alliance is restricted to wetlands in Kansas and Oklahoma. Stands are dominated by medium-tall graminoids. Typical graminoids include Eleocharis palustris (= Eleocharis macrostachya), Eleocharis compressa, Leptochloa fusca ssp. fascicularis (= Leptochloa fascicularis), Ambrosia artemisiifolia, Coreopsis tinctoria, Marsilea vestita, and others. Further study is needed to characterize this alliance……..go to 29

29. **Eleocharis palustris - (Eleocharis compressa) - Leptochloa fusca ssp. fascicularis Herbaceous Vegetation**

This spikerush basin wetland is found in the south-central Great Plains of the United States. Stands occur in wet depressions, bison wallows, interdunal swales, and playa lakes. Soils are poorly drained, dense clays. The vegetation is dominated by low (<0.5 m) graminoids and forbs. Eleocharis macrostachya is dominant or codominant. Other species that may be present include Ambrosia artemisiifolia, Ambrosia grayi, Symphyotrichum subulatum (= Aster subulatus), Coreopsis tinctoria, Eleocharis compressa, Hordeum jubatum, Leptochloa fusca ssp. fascicularis (= Leptochloa fascicularis), Marsilea vestita, Polygonum pensylvanicum (= Polygonum bicorne), and others

30a. Common Reed is domain……..go to 31

30b. Common Reed is not dominant……go to 33

31. **Phragmites australis Semipermanently Flooded Herbaceous Alliance**

This alliance consists of non-tidal Phragmites marshes with semi-permanently or, rarely, seasonally flooded hydrology, occurring either in depressions or along rivers with seasonal fluctuation in water level throughout the United States and adjacent Canada. This includes semi-permanently flooded marshes, ditches, impoundments, etc., which are strongly dominated by essentially monospecific stands of Phragmites australis, which is rapidly spreading in disturbed areas and excluding native vegetation. Stands may be composed entirely of Phragmites australis, with few or no other vascular plants present……go to 32

32. **Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation**

This reed marsh type is found across the west-temperate regions of the United States and Canada. Stands occur in semi-permanently flooded marshes, ditches, impoundments, etc. that

have often been disturbed by human activity. The vegetation is often variable, as Phragmites australis will often invade into existing natural or semi-natural communities present on the site. Once firmly established, this community is usually strongly dominated by Phragmites australis, with few or no other vascular plants present. In Colorado, this reed marsh often occurs in small wet patches in seeps and backwater areas of large floodplains, around the fringes of irrigation ponds, ditches, and along railroad embankments that have poor drainage. Stands have a dense, 1- to 1.5-m tall herbaceous layer dominated by the perennial graminoid Phragmites australis. Minor cover of associates such as Agrostis stolonifera, Carex spp., Conyza canadensis, Glycyrrhiza lepidota, Iva axillaris, Mentha arvensis, Schoenoplectus acutus (= Scirpus acutus), and Typha latifolia may be present.

33a.Three-Square is dominant……go to 34

33b. Three-Square is not dominant……..go to 36

34. **Schoenoplectus pungens Semipermanently Flooded Herbaceous Alliance**

This alliance, found in the northern Great Plains, Utah, Nevada, and southern British Columbia and Alberta, Canada, is made up of graminoid-dominated communities found in saline or alkaline wetlands. This alliance occurs in depressions and stream or river valleys. The loam to sandy loam soils are deep, poorly drained and formed in alluvium (Steinauer 1989). These soils are slightly to strongly affected by soluble salt. Standing water is at or near the surface for most of the year. Medium-tall and short graminoids predominate. Woody species are very uncommon. Schoenoplectus pungens (= Scirpus pungens), Suaeda calceoliformis, Distichlis spicata (on drier margins), and Ruppia maritima are all common species. Chenopodium incanum, Monolepis nuttalliana, and Picradeniopsis oppositifolia are sometimes abundant on less saline portions of the alliance……..go to 35

35. **Schoenoplectus pungens Herbaceous Vegetation**

This bulrush wet meadow community is found in the western United States in the intermountain basins, as far north as southern British Columbia, as well as in western parts of the Great Plains north into Alberta, Canada. Stands are found along low-gradient, meandering, usually perennial streams and springs and around the margins of ponds and marshes. Substrates are generally dark, organic, fine-textured soils derived from alluvium. Schoenoplectus pungens (= Scirpus pungens) dominates the dense, 0.3- to 0.6-m tall herbaceous vegetation layer. Other species that often are present include Schoenoplectus maritimus (= Scirpus maritimus), Spartina gracilis, Hordeum jubatum, Pascopyrum smithii, Juncus balticus, Eleocharis palustris, Lemna minor, Sagittaria latifolia, and Typha spp. Stands of this association contain no tree or shrub layer, but a few scattered trees and shrubs may be present, most commonly Populus deltoides, Populus fremontii, Salix amygdaloides, Salix exigua, Salix gooddingii, Symphoricarpos occidentalis, or Sarcobatus vermiculatus.

36a. Prairie Cordgrass is dominant……go to 37

36b. Prairie Cordgrass is not dominant……..go to 39

37. **Spartina Pectinata Temporarily Flooded Herbaceous Alliance**

This alliance is found primarily in central North America. This description is based on this alliance as it occurs in the Midwest. Stands of this wide-ranging alliance are found on level to gently sloping sites with sand, loam, or clay soils. They occur near lakes or rivers or in depressions. All sites are typically flooded for part of the winter and spring. In the east, stands can experience droughty conditions in the summer and fall (Comer et al. 1995), while in the south and central portion of this alliance's range they can remain saturated for much of the growing season. The vegetation of this alliance is characterized by dense stands of graminoids 1-2 m tall with scattered to very infrequent woody plants. The most abundant species are Calamagrostis canadensis, Carex aquatilis, Carex atherodes, Carex pellita (= Carex lanuginosa), Carex sartwellii, and Spartina pectinata. In some stands, Spartina pectinata can form virtual monocultures. Other common graminoids include Andropogon gerardii, Muhlenbergia richardsonis, Panicum virgatum, Poa palustris (in the western part of this alliance's range), and Sorghastrum nutans. Forbs are abundant and include Symphyotrichum ericoides (= Aster ericoides), Symphyotrichum novae-angliae (= Aster novae-angliae), Helianthus grosseserratus, Lythrum alatum, Pycnanthemum virginianum, and Thalictrum dasycarpum. Shrubs and small trees are infrequent in the south and west but are often present in the north and east. Among these Cornus spp., Fraxinus pennsylvanica, and Salix spp. are typical.

This alliance occurs in the Southeast only as small disjunct occurrences in Oklahoma, the Upper West Gulf Coastal Plain of Kentucky, and possibly extending a short distance into adjacent Tennessee. Associates in Kentucky and Tennessee occurrences may include Helianthus angustifolius, Viola sagittata, Cephalanthus occidentalis, Andropogon gerardii, Dichanthelium scoparium, Schizachyrium scoparium, Sorghastrum nutans, Tripsacum dactyloides, Asclepias tuberosa, Baptisia alba var. macrophylla (= Baptisia leucantha), Crotalaria sagittalis, Dichanthelium clandestinum, Agalinis fasciculata, Helianthus grosseserratus, Helianthus mollis, Heterotheca villosa (= Chrysopsis villosa), Spiranthes cernua, Rhexia mariana, Rudbeckia hirta, Rudbeckia subtomentosa, and Viola sagittata. In Kentucky, this vegetation is at present probably seasonally saturated; it was presumably formerly seasonally flooded. In Oklahoma, this alliance contains Spartina pectinata with Eleocharis montevidensis and Carex spp.
……..go to 38

38. **Spartina pectinata - Eleocharis spp. - Carex spp. Herbaceous Vegetation**

This wet grassland community is found in the southern Great Plains on deep, poorly drained soils on level to nearly level sites near lakes, seeps, or alluvial lowlands. The soils are usually inundated for short periods during the year but may be saturated for much of the growing season. In northeastern, central, and western Oklahoma (i.e., excluding the Coastal Plain and the Oklahoma panhandle), this association occurs in floodplains, backswamps, and lake margins This community is characterized by tall, dense graminoids with moderate forb diversity and few woody species. The dominant species, Spartina pectinata, can form near monocultures in some

locations. Common species include Carex annectens, Carex blanda, Eleocharis spp., Juncus interior, Juncus torreyi, Panicum virgatum, Rumex altissimus, and Verbena hastata. Other characteristic species in Oklahoma include Ammannia coccinea, Paspalum laeve, Pluchea odorata, and Vernonia baldwinii, and in Kansas include Asclepias incarnata, Symphyotrichum lanceolatum (= Aster lanceolatus), Baptisia alba var. macrophylla (= Baptisia lactea), Helianthus grosseserratus, and Scirpus atrovirens.

39a.Cattails are dominant or co-dominant with Rushes……..go to 40

39b. Rushes dominant……..……go to 45

40a Cattail alone is dominant……..go to 41

40b. Cattail and Rush are co-dominant……..……go to 43

41. **Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Semipermanently Flooded Herbaceous Alliance**

This alliance, found in virtually every state in the United States and probably most Canadian provinces, contains stands dominated by Typha angustifolia and/or Typha latifolia, either alone or in combination with other tall emergent marsh species. This alliance is found most commonly along lake margins and in shallow basins, and occasionally in river backwaters. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. Typha angustifolia can grow in deeper water compared to Typha latifolia, although both species reach maximum growth at a water depth of 50 cm. Typha often occurs in pure stands, and can colonize areas recently exposed by either natural or human causes. Lythrum salicaria, an exotic species from Europe, has become a common associate of many eastern Typha marshes. In the Southeast, this alliance is widespread and currently representative of a wide variety of mixed marshes with no clear dominants. Vegetation in this alliance may be natural or semi-natural and includes mixed stands of the nominal species, as well as essentially monospecific stands of Typha latifolia. These monospecific stands occur especially in artificial wetlands, such as borrow pits or ponds. This alliance occurs on hydric soils in wetlands, ditches, ponds, lakes, and rivers, as well as on shorelines and streambanks. Inundation is commonly 3-6 dm (1-2 feet) in depth. These marshes have hydric soils and are flooded with water levels ranging from several centimeters to more than 1 m for a significant part of the growing season. Occurrences may display areas of open water, but emergent vegetation dominates (80% cover). Seasonal flooding during winter and spring or flooding during heavy rains help maintain these marshes by causing water exchange which replenishes freshwater and circulates nutrients and organic debris. Soils which support this community can be mineral or organic but are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part. Vegetative diversity and density is highly variable in response to water depth, water chemistry, and natural forces. Associated species vary widely; in the Midwest they include many sedges such as Carex

aquatilis, Carex rostrata, Carex pellita (= Carex lanuginosa), bulrushes such as Schoenoplectus americanus (= Scirpus americanus), Schoenoplectus acutus (= Scirpus acutus), and Schoenoplectus heterochaetus (= Scirpus heterochaetus), and broad-leaved herbs such as Thelypteris palustris, Asclepias incarnata, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum, Hibiscus moscheutos, and Verbena hastata. Floating aquatics such as Lemna minor may predominate in deeper zones……..go to 42

42. **Typha spp. Great Plains Herbaceous Vegetation**

This cattail community type is found throughout the Northern Great Plains of the United States and Canada. Stands occur in shallow (<0.5 m) or deep depressions, stock ponds, and seepy drainages. The vegetation is dominated by relatively pure stands of Typha spp., either Typha latifolia or Typha angustifolia or both. Many associates can occur, including Eleocharis spp. and Sagittaria latifolia. This type may simply be a less diverse variation of Typha spp. - Schoenoplectus spp. - Mixed Herbs Great Plains Herbaceous Vegetation that arises in disturbed wetland areas.

43. **Typha spp. - (Schoenoplectus spp., Juncus spp.) Seasonally Flooded Herbaceous Alliance**

This alliance, found in the midwestern United States and the central provinces of Canada, is characterized by emergent graminoids and forbs in shallow marshes. These shallow marshes have soils that are saturated to inundated by standing water up to 15 cm in depth throughout much of the growing season. Shallow aquatics such as Sparganium eurycarpum or Sagittaria latifolia may be more diagnostic than Typha spp. or Schoenoplectus spp. (= Scirpus spp.). Other species present include Carex comosa, Lemna minor, and Rumex orbiculatus. Further work is needed to characterize this alliance……..go to 44

44. **Schoenoplectus tabernaemontani - Typha spp. - (Sparganium spp., Juncus spp.) Herbaceous Vegetation**

This shallow marsh mixed emergent community ranges broadly over the midwestern United States and adjacent Canada. It is found in basin-like depressions, backwater areas of floodplains, and shallow margins of lakes or ponds. Soils are shallow to deep, very poorly drained, consisting of peats, mucks, or mineral materials, often found in alluvium. Vegetation varies from zones dominated by tall emergents 1-2 m tall to those with hydrophytic annual and perennial forbs <1 m tall. In the tall emergent zone, Schoenoplectus tabernaemontani (= Scirpus tabernaemontani), Schoenoplectus fluviatilis (= Scirpus fluviatilis), Schoenoplectus acutus (= Scirpus acutus), Typha angustifolia, and Typha latifolia may dominate, mixed with a variety of other herbaceous species, such as Leersia oryzoides, Eleocharis palustris, Juncus spp., and Sparganium spp. The hydrophytic annual and perennial forb zone is dominated by Alisma subcordatum, Alisma triviale, Sagittaria latifolia, Sparganium eurycarpum, Pontederia cordata, along with Bacopa rotundifolia and Heteranthera limosa. Occasional floating-leaved aquatics are sometimes present, including Azolla caroliniana, Lemna spp., Spirodela polyrrhiza, and Utricularia macrorhiza.

45. **Schoenoplectus tabernaemontani (Schoenoplectus acutus) Semipermanently Flooded Herbaceous Alliance**

This is an alliance for areas with a pure stand of soft or hardstem bulrush. These often occur in small shallow isolated wet depressions away from major water areas. Stands are thick and are usually buffered by other wetland communities……..……..go to 46

46. **Schoenoplectus tabernaemontani (Schoenoplectus acutus) Semipermanently Flooded Herbaceous Vegetation**

This is an association for areas with a pure stand of soft or hardstem bulrush. These monotypic stands are inundated at least part of the year

<u>Sparse Vegetation</u>

1a. Area is covered in water……go to 2

1b. Area is not covered in water……go to 4

2. **Water Alliance**

These areas are made up of depressions that collect water. Areas that are covered in water most to all of the year, When filled with shallow water Polygonum spp. can grow but if drying occurs then moist soil vegetation maybe present……go to 3

3 **Water**

These are areas that are covered in standing water for most of the year and contain very little vegetation except during small windows of the year when water levels are low or drying has occurred.

4a. Area has a building or structure present……..go to 5

4b. Area does not have a building or structure present……go to 7

5. **Buildings or Structures Alliance**

Areas on the refuge that have a permanent man-made structure or building…….go to 6

6. **Buildings or Structures**

Areas on the refuge that have a permanent man-made structure or building

7a. Area is a road……go to 8

7b. Area is not a road……..……..go to 10

8. **Roads Alliance**

Areas that are maintained dirt roads or roads that are paved……..go to 9

9. **Roads**

Areas that are maintained dirt roads or roads that are paved

10a. Area has Prairie Dog Burrows Present……go to 11

10b. Area does not have Prairie Dog burrows present……..go to 13

11. **Grassland Complex Herbaceous Alliance**

This is technically not an alliance. It is a placeholder for a group of sparsely vegetated associations that do not have adequate vegetation descriptions, but do share certain substrate characteristics……..go to 12

12. **Black tailed Prairie Dog Town Grassland Complex**

The prairie dog town is noteworthy for its short (< 20 cm) vegetation, limited diversity, and regular prairie dog holes. Prairie dogs keep sight lines open by clipping plants, and maintaining vegetation in the early growth stage. They also increasing bare ground, increasing the percentage of forb cover, and alter long-term soil-building processes through bioturbation, or mixing of soil horizons. Many of the plants are annual, growing in nearly monotypic patches possible herbaceous species found on site are Setaria pumila, Aristida oligantha, Conyza ramosissima, Kochia scoparia, Oxalis dillenii, Cirsium ochrocentrum, and Convolvulus arvense. Prairie dog town grassland complex is found on level to moderately sloping sites of all aspects on highly disturbed soil.

13a. Area has bare ground due to being flooded parts of the year……..go to 14

13b. Area has bare ground due to human alteration……go to 16

14. **Sand Flats Temporarily Flooded Sparsely Vegetated Alliance**

This is technically not an alliance. It is a placeholder for a group of sparsely vegetated associations that do not have adequate vegetation descriptions, but do share certain substrate characteristics……go to 15

15. **Riverine Sand Flats-Bars Sparse Vegetation**

This community ranges from the western Great Plains to the eastern parts of the midwestern United States and Canada. It is a sparsely vegetated community that occurs along river shorelines, islands, pointbars, and flats. These sandbars form when receding floodwaters deposit sand and lesser amounts of clay, silt, and cobbles in the stream bed. Soils are often undeveloped due to the ephemeral nature of the stands. Drainage depends on depth above the

water level. Herbaceous species shared in Missouri and Nebraska include Cyperus spp. (Cyperus erythrorhizos, Cyperus odoratus, Cyperus squarrosus), Eragrostis hypnoides, Eragrostis trichodes, Leptochloa fusca ssp. fascicularis (= Leptochloa fascicularis), Polygonum spp. (including Polygonum lapathifolium), Rorippa sinuata, Sporobolus cryptandrus, and Xanthium strumarium.

16. **Bare Ground Alliance**

This alliance occurs in areas that do not contain vegetation due to human alteration of the land. These areas or are disturbed due to man-made alterations to the area……go to 17

17. **Bare Ground**

This is an alliance with areas that do not contain vegetation due to human alteration of the land.

Appendix D: Coverage of NVCS Vegetation Alliances on Quivira NWR in 2008.

NVCS Vegetation Alliance	Acres	Hectares
Acer Negundo Woodland	0.3	0.1
Agriculture Vegetation	885.9	358.5
Ailanthus altissima Forest	7.8	3.1
Andropogon gerardii - (Calamagrostis canadensis, Panicum virgatum) Herbaceous	551.2	223.1
Andropogon gerardii - (Sorghastrum nutans) Herbaceous	426.4	172.6
Andropogon hallii Herbaceous	62.5	25.3
Bare Ground	18.9	7.6
Bromus tectorm Semi-natural Herbaceous Vegetation	82.1	33.2
Catalpa speciosa Forest	11.9	4.8
Celtis occidentalis Woodland	0.6	0.3
Cornus drummondii Shrubland	22.7	9.2
Distichlis spicata - (Hordeum jubatum) Temporarily Flooded Herbaceous	4926.1	1993.5
Elaeagnus angustifolia Woodland	29.2	11.8
Eleocharis palustris Temporarily Flooded Herbaceous	329.3	133.3
Fraxinus pennsylvanica Forest	3.1	1.3
Grassland Complex Herbaceous	18.9	7.6
Gymnocladus dioica Forest	16.2	6.6
Juniperus virginiana Semi-natural Forest	85.4	34.5
Maclura pomifera Woodland	5.6	2.3
Morus rubra Woodland	8.0	3.3
Panicum virgatum	1676.8	678.6

NVCS Vegetation Alliance	Acres	Hectares
Phragmites australis Semipermanently Flooded Herbaceous	72.5	29.3
Populus deltoides Temporarily Flooded Forest	389.5	157.6
Prunus spp. Shrubland	1231.1	498.2
Rhus aromatica Shrubland	28.1	11.4
Robinia pseudoacacia/Gleditsia triacanthos Forest	253.8	102.7
Salix (exigua, interior) Temporarily Flooded Shrubland	57.1	23.1
Sand Flats Temporarily Flooded Sparsely Vegetated	936.3	378.9
Sapindus saponaria Woodland	1.6	0.6
Schizachyrium scoparium - Bouteloua curtipendula Herbaceous	2058.8	833.2
Schoenoplectus pungens Semipermanently Flooded Herbaceous	1107.6	448.2
Schoenoplectus tabernaemontani (Schoenoplectus acutus) Semi-permanently Flooded Herbaceous	167.9	68.0
Spartina Pectinata Temporarily Flooded Herbaceous	1293.6	523.5
Tamarix spp. Semi-natural Temporarily Flooded Shrubland	126.4	51.2
Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Semi-permanently Flooded Herbaceous	1615.0	653.6
Typha spp. - (Schoenoplectus spp., Juncus spp.) Seasonally Flooded Herbaceous	366.9	148.5
Ulmus Americana Woodland	1.9	0.8
Ulmus pumila Woodland	50.6	20.5
Urochloa mutica Herbaceous	2.8	1.1

Appendix E: Coverage of NVCS Vegetation Associations on Quivira NWR in 2008.

Vegetation Associations	Acres	Hectares
Acer Negundo Woodland	0.3	0.1
Agriculture Vegetation	885.9	358.5
Ailanthus altissima Forest	7.8	3.1
Andropogon gerardii - Panicum virgatum – Helianthus Herbaceous Vegetation	551.2	223.1
Andropogon gerardii - Sorghastrum nutans Western Great Plains Herbaceous Vegetation	426.4	172.6
Andropogon hallii- Calamovilfa longifolia Herbaceous Vegetation	62.5	25.3
Bare Ground	18.9	7.6
Black tailed Prairie Dog Town Grassland Complex	18.9	7.6
Bromus tectorm Semi-natural Herbaceous Vegetation	82.1	33.2
Catalpa speciosa Forest	11.9	4.8
Celtis occidentalis Woodland	0.6	0.3
Cornus drummondii – (Rhus glabra, Prunus spp.) Shrubland	22.7	9.2
Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides) Herbaceous Vegetation	4926.1	1993.5
Elaeagnus angustifolia Woodland	29.2	11.8
Eleocharis palustris-(Eleocharis compressa) Leptochloa fusca ssp. Fascicularis Herbaceous Vegetation	329.3	133.3
Fraxinus pennsylvanica Forest	3.1	1.3
Gymnocladus dioicus Forest	16.2	6.6
Juniperus virginiana Semi-natural Forest	85.4	34.5
Maclura pomifera Woodland	5.6	2.3
Morus rubra Woodland	8.0	3.3

Vegetation Associations	Acres	Hectares
Panicum virgatum Vegetation	431.8	174.8
Panicum virgatum-Sorghastrum nutans Vegetation	1245.0	503.8
Phragmites australis Western North American Temperate Semi-natural Herbaceous Vegetation	72.5	29.3
Populus deltoides –Salix nigra Forest	389.5	157.6
Prunus spp. Shrubland	1231.1	498.2
Rhus aromatica Shrubland	28.1	11.4
Riverine Sand Flats-Bar Sparse Vegetation	936.3	378.9
Robinia pseudoacacia/Gleditsia triacanthos Forest	253.8	102.7
Salix exigua/Mesic Graminoids Shrubland	57.1	23.1
Sapindus saponaria Woodland	1.6	0.6
Schizachyrium scoparium - Bouteloua curtipendula Western Great Plains Herbaceous Vegetation	2058.8	833.2
Schoenoplectus pungens Herbaceous Vegetation	1107.6	448.2
Schoenoplectus tabernaemontani (Schoenoplectus acutus) Semi-permanently Flooded Herbaceous Vegetation	167.9	68.0
Schoenoplectus tabernaemontani- Typha spp.-(Sparganium spp., Juncus spp.) Herbaceous Vegetation	366.9	148.5
Spartina Pectinata –Eleocharis spp. Carex spp. Herbaceous Vegetation	1293.6	523.5
Tamarix spp. Semi-natural Temporarily Flooded Shrubland	126.4	51.2
Typha spp. Great Plains Herbaceous Vegetation	1615.0	653.6
Ulmus Americana Woodland	1.9	0.8
Ulmus pumila Woodland	50.6	20.5
Urochloa mutica Herbaceous Vegetation	2.8	1.1

Appendix F: Photo Interpretation Mapping Conventions and Visual Keys

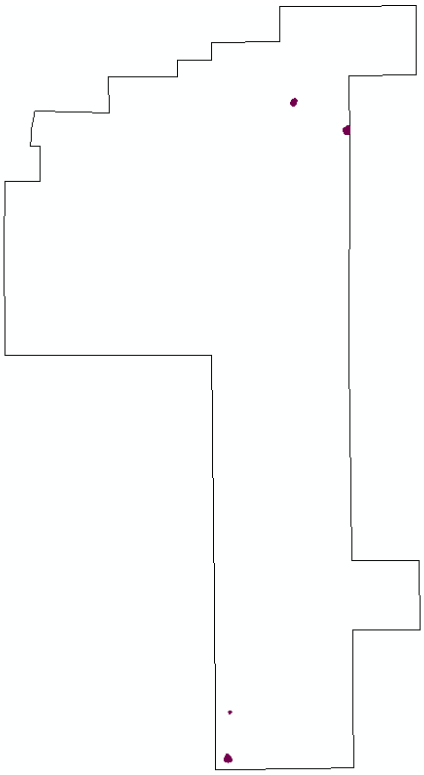
CEGL007191 Tree of Heaven Forest

Ailanthus altissima Forest

Dominant Vegetation

Tree of Heaven (Ailanthus altissima)

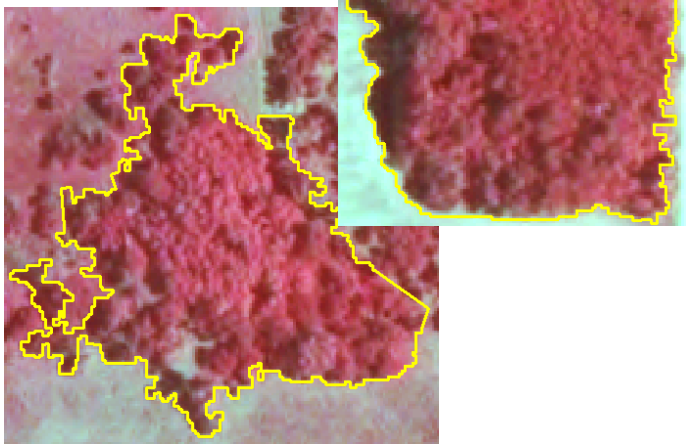
Range and Distribution



Description

There are a few stands of Tree of Heaven on the Refuge in the Southwest corner and in the in the North Dead Horse Slough Area. This invasive association grows in a monotypic stand in shelterbelts on the refuge. It is very difficult to pick out Tree of Heaven among the differ type of tree stands on the refuge. Tree of Heaven is Red to dark pink and closely clumped on the imagery.

Representation Ground Photo
Photo Signature Examples



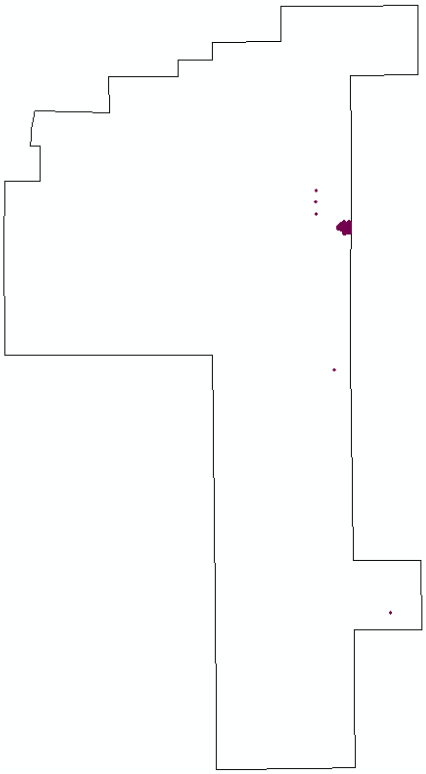
QVR_1a Northern Catalpa Forest

Catalpa speciosa Forest

Dominant Vegetation

Northern Catalpa (Catalpa speciosa)

Range and Distribution

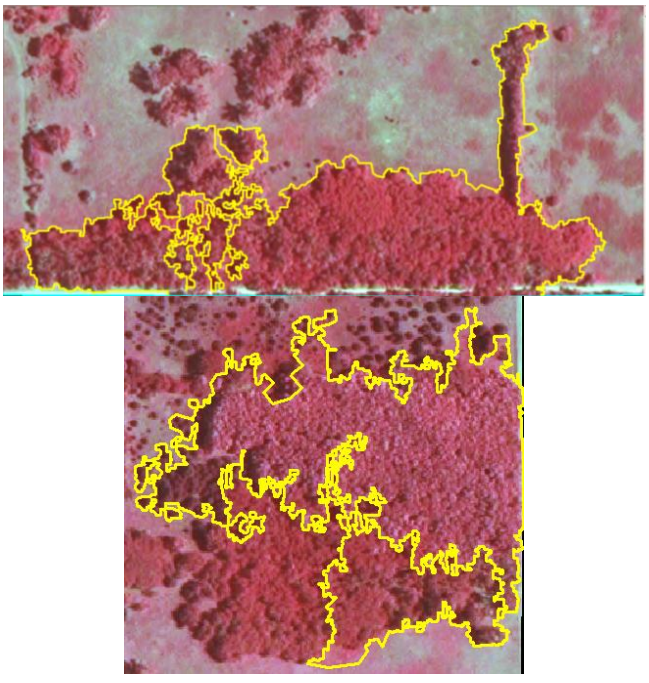


Description

This association is located in the South Dead Horse Slough unit of the refuge and in the Southwest Little Salt Marsh Unit. It often mixes with other trees which can include red cedar, pine, and cottonwood. The trees in catalpa groves are very close together. More monotypic stands of Catalpa are a medium pink in color and mixed stands tend to have more red in them.

Representation Ground Photo

Photo Signature Examples

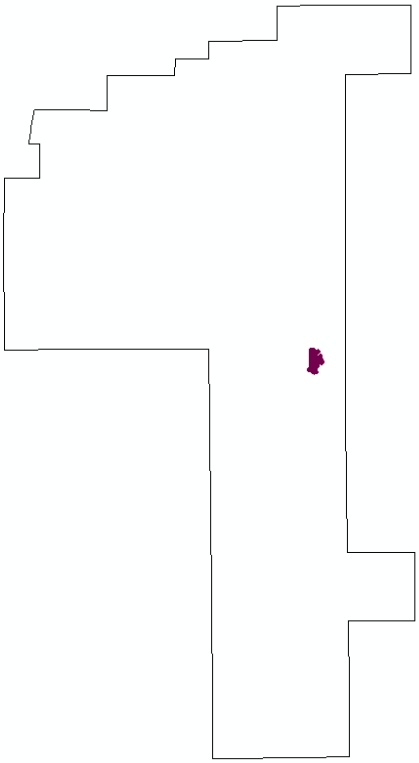


QVR_5a Kentucky Coffee Tree Forest

Gymnocladus dioicus Forest

Dominant Vegetation

Range and Distribution

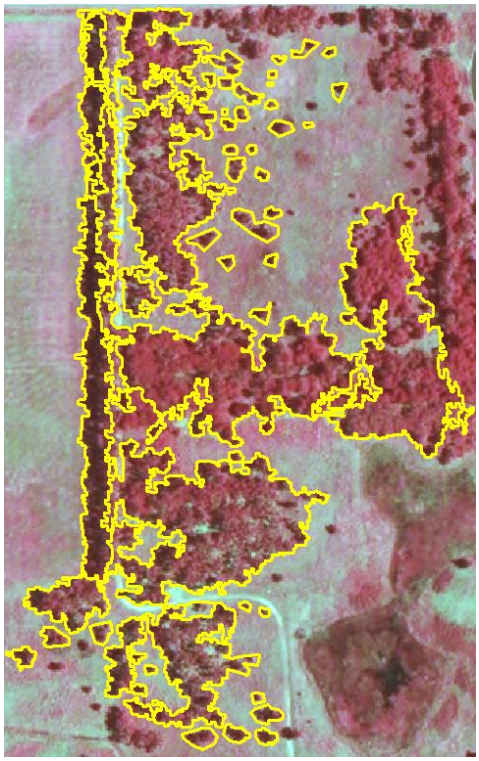


Description

There is one section of the refuge that contains large stands of Kentucky coffee tree. The stand is located in Northwest Darrynane. This tree grows in a monotypic stand. It is difficult to distinguish from other Tree stands on the refuge. The imagery is a medium red with tree crowns close together.

Representation Ground Photo

Photo Signature Examples



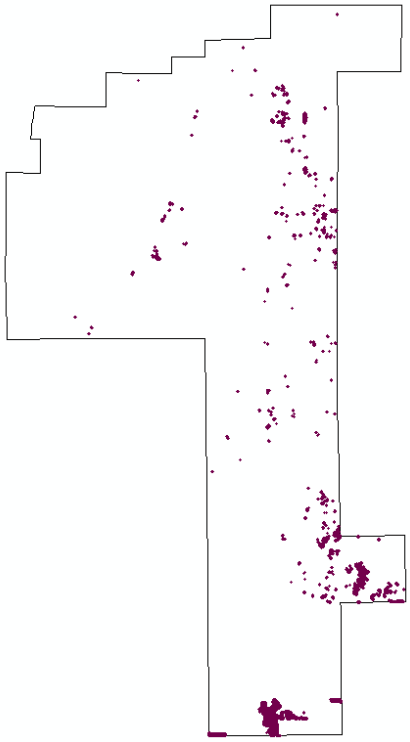
CEGL002593 Red Cedar Semi-natural Forest

Juniperus virginiana Semi-natural Forest

Dominant Species

Red Cedar (Juniperus virginiana)

Range and Distribution

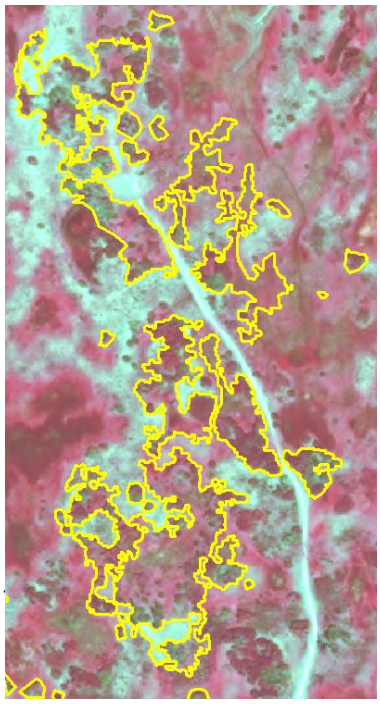


Description

This association occurs primarily in shelter belt areas where it was planted by people but occasionally small groups of trees exist. Red Cedar is also a common secondary tree in many shelter belts. On the imagery red cedar is loosely clumped or in solid tree stands. The trees are darker dull red compared to other stands of trees. There are tree stands in several area of the refuge but they are the most predominant in South Dead Horse Slough and the South End of Little Salt Marsh.

Representation Ground Photo

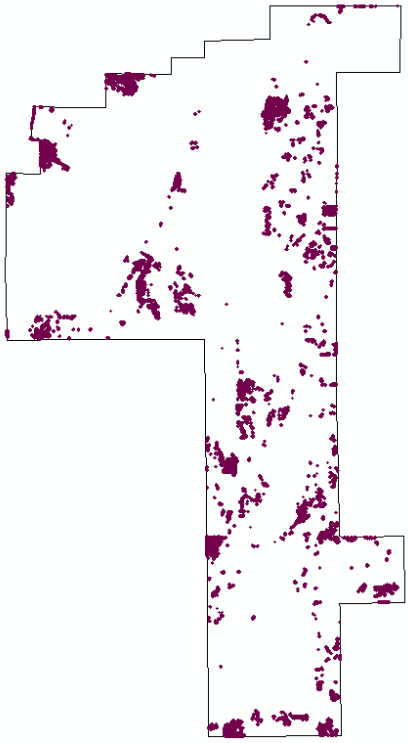
Photo Signature Examples



CEGL002018 Cottonwood-Black Willow Forest

Range and Distribution

Populus deltoids-Salix nigra Forest



Dominant Vegetation

Cottonwood (Populus deltoids)

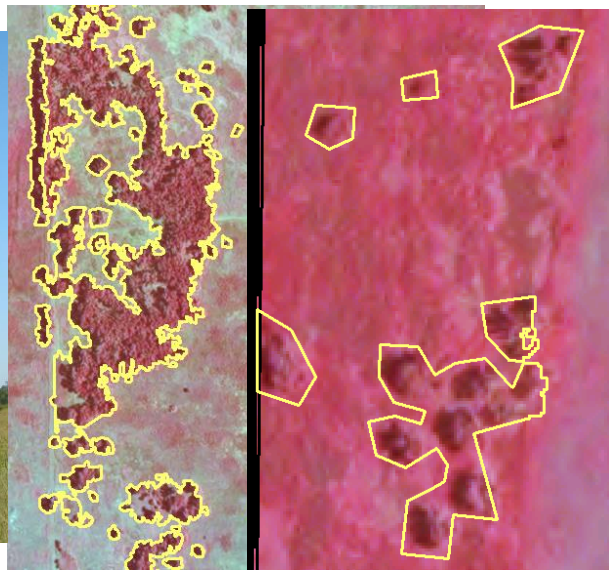
Red Cedar (Juniperus virginiana)

Description

Cottonwood trees are scattered throughout the refuge in saturated areas. Willow plays little to no role in this association. Often Red Cedar is an understory plant in this association. Cottonwood either creates solid stands or loose clumps. Cottonwood appears as dark red distinctive uneven circles on the imagery.

Representation Ground Photo

Photo Signature Examples



QVR_26a Black and Honey Locust Forest

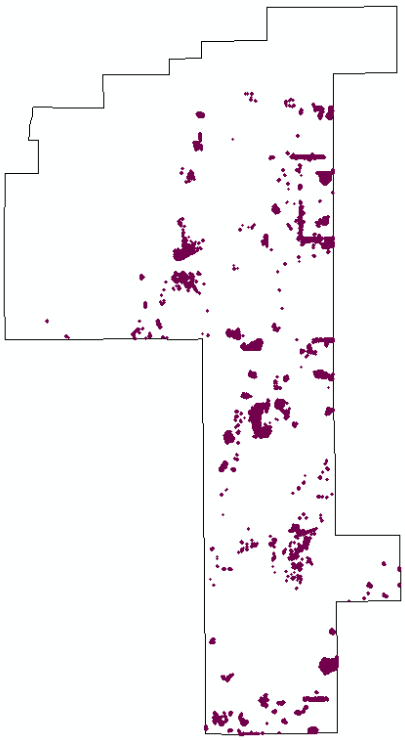
Robinia pseudoacacia/Gleditsia triacanthos Forest

Dominant Vegetation

Black Locust (Robinia pseudoacacia)

Honey Locust (Gleditsia triacanthos)

Range and Distribution

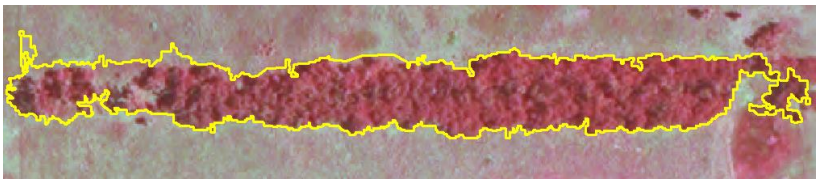


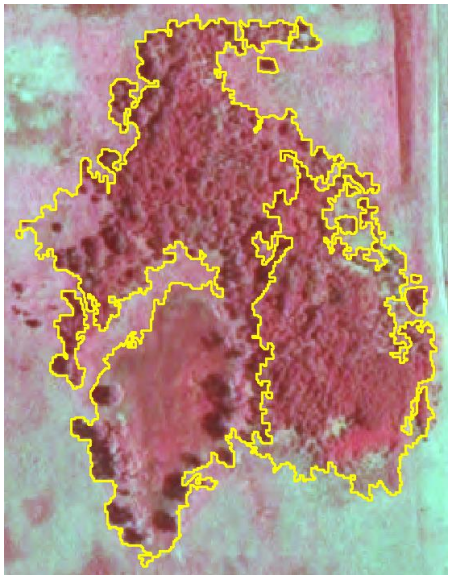
Description

Locust is spread in tree groves across the refuge. This invasive association occurs in either pure stands of Black Locust or sometimes with Honey Locust as a secondary species. In the imagery the locust looks like dark red with distinct large trees.

Representation Ground Photo

Photo Signature Examples





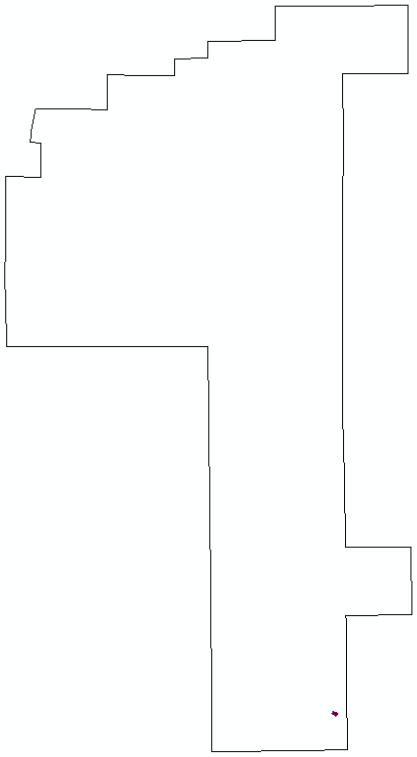
QVR_13a Box Elder Woodland

Acer negundo Woodland

Dominant Vegetation

Box Elder (Acer negundo)

Range and Distribution

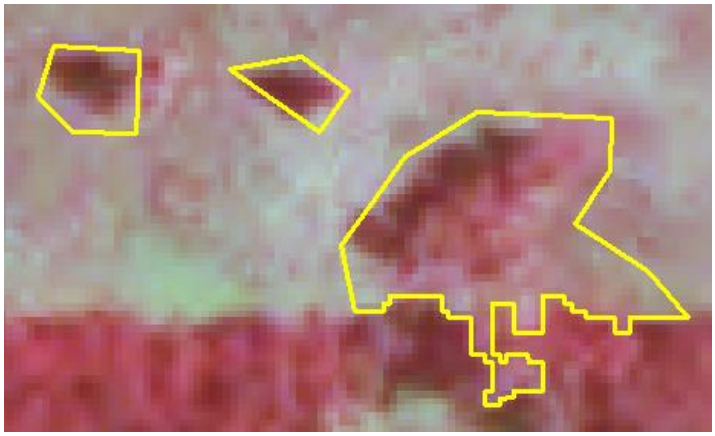


Description

Box Elder can be found in a few scattered clumps throughout the refuge. This association may be an inclusion in another vegetation category. The shape of these trees is somewhat variable but they are dark in color on the imagery and often not close to other trees.

Representation Ground Photo

Photo Signature Examples



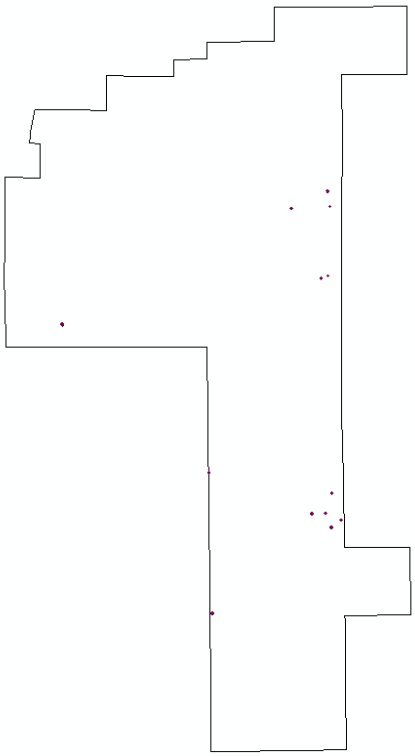
QVR_20a Hackberry Woodland

Celtis occidentalis Woodland

Dominant Vegetation

Hackberry (Celtis occidentalis)

Range and Distribution

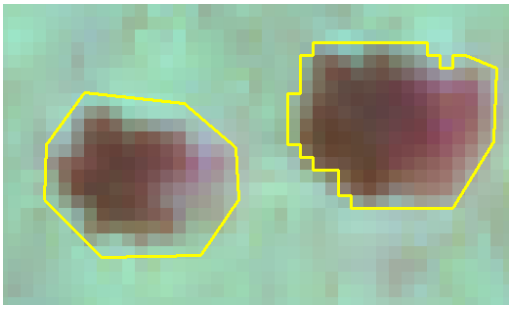


Description

Box Elder can be found in a few scattered clumps throughout the refuge. This association may be an inclusion in another vegetation category. The shape of these trees is somewhat variable but they are dark in color on the imagery and often not close to other trees.

Representation Ground Photo

Photo Signature Examples

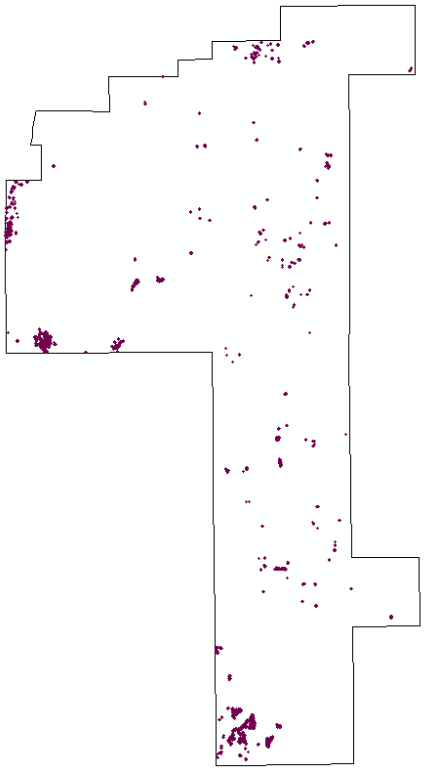


QVR_8a Russian Olive Woodland

Elaeagnus angustifolia Woodland

Dominant Vegetation

Range and Distribution

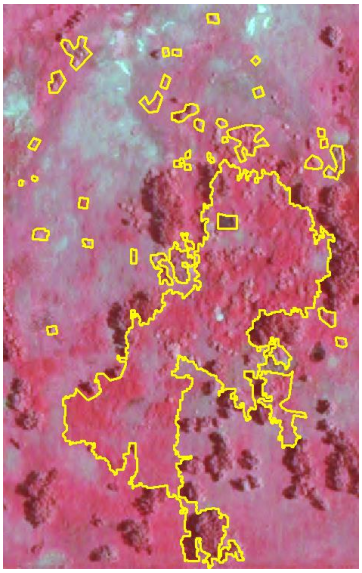


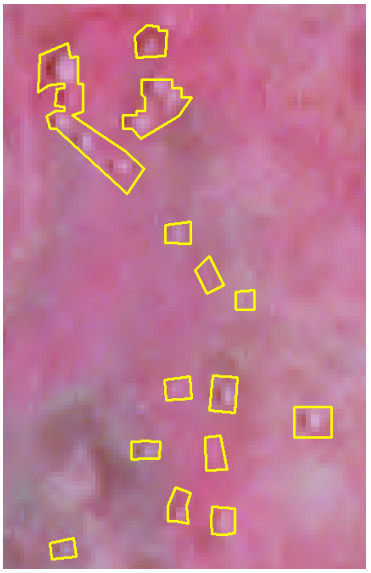
Description

Russian olive occurs in tree stands throughout the refuge either alone, with Tamerisk, or in the understory of larger trees like tamerisk. It lives in areas moist most of the year and often occur not far from large water sources. On the imagery the trees are a very light pink in color and round in shape with some dark around the edge.

Representation Ground Photo

Photo Signature Examples





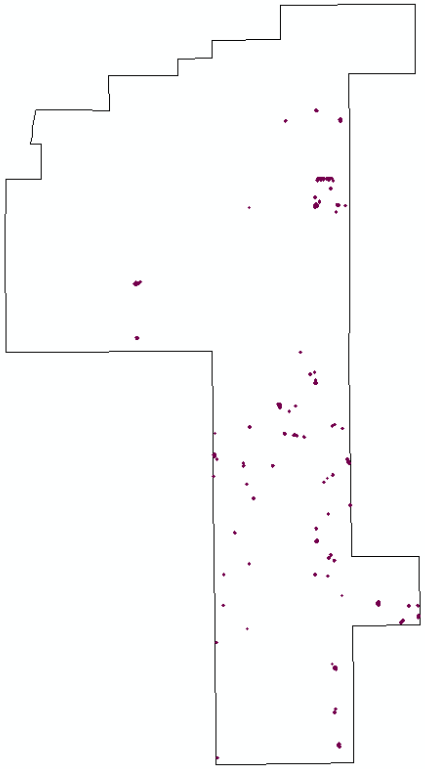
QVR_12a Mulberry Woodland

Morus rubra Woodland

Dominant Vegetation

Mulberry (Morus rubra)

Range and Distribution

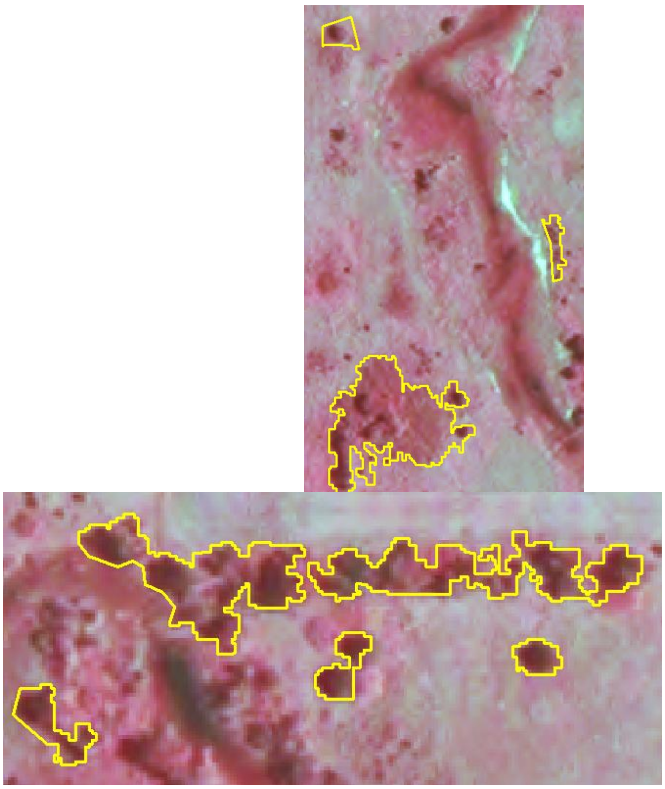


Description

Mulberry can be found in a few scattered clumps throughout the refuge. This association may be an inclusion in another vegetation category. The shape of these trees is somewhat variable but they are dark in color on the imagery and often not close to other trees.

Representation Ground Photo

Photo Signature Examples



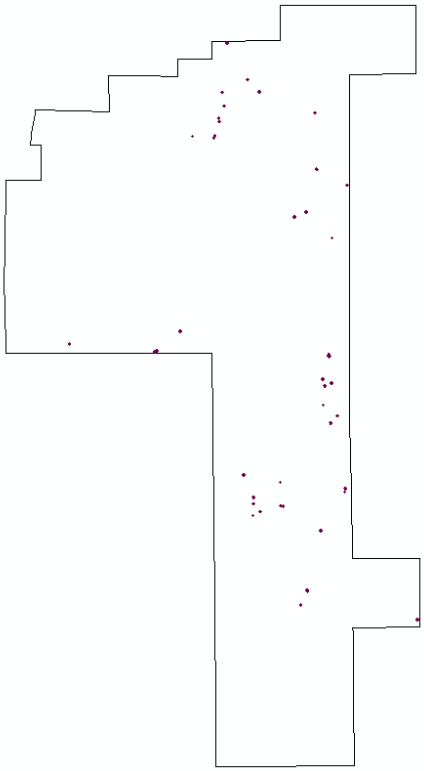
QVR_23a American elm Woodland

Ulmus Americana Woodland

Dominant Vegetation

American elm (Ulmus Americana)

Range and Distribution

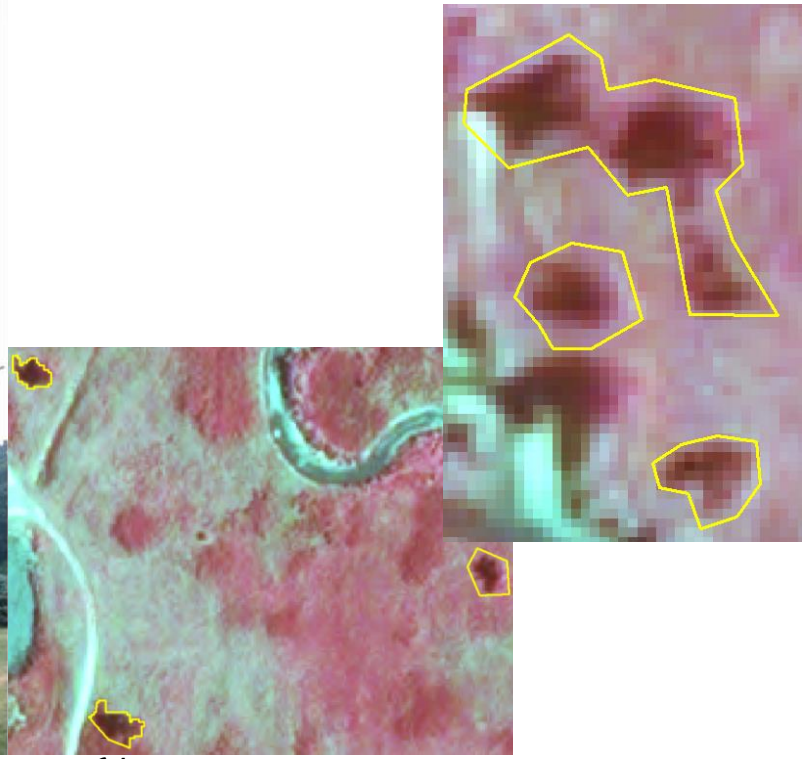


Description

There are loose scattered stands of American elm on the outskirts of tree stands or in open pasture. This association may be an inclusion in another vegetation category. The shape of these trees is somewhat variable but they are dark in color on the imagery and often are not close to other trees.

Representation Ground Photo

Photo Signature Examples



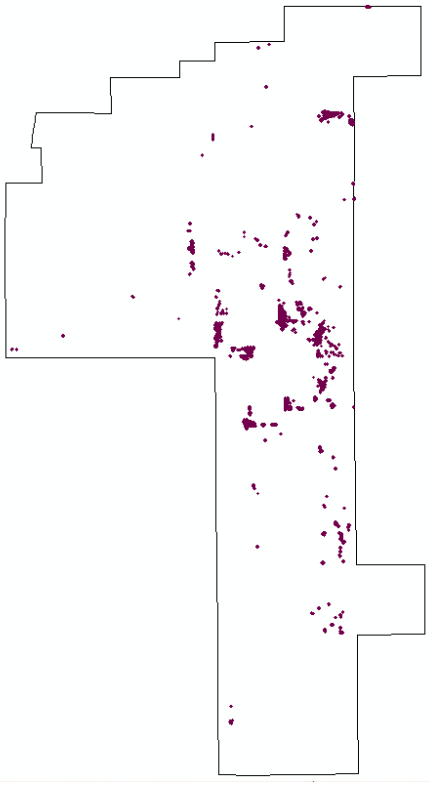
QVR_6a Siberian Elm Woodland

Ulmus pumila Woodland

Dominant Vegetation

Siberian Elm (Ulmus pumila)

Range and Distribution



Description

This woodland is dominated by a monoculture of Siberian Elm. It occurs in tree stands throughout the refuge. Siberian elm lives in areas that were formally upland grasslands. On the imagery the trees are dark and irregularly shaped unlike cottonwood which is usually bigger and has round trees.

Representation Ground Photo

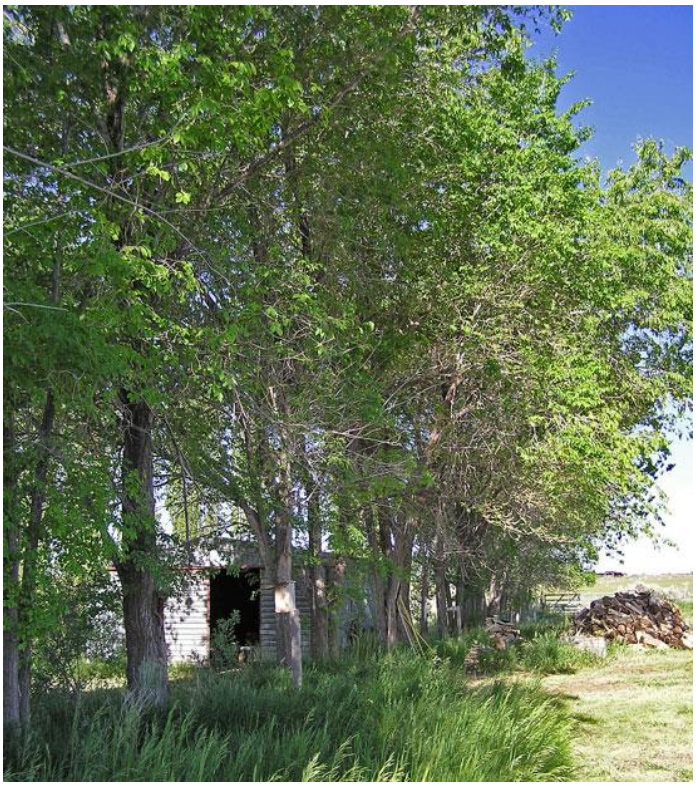
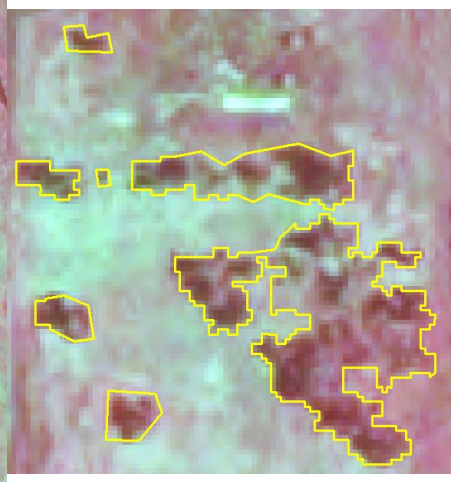


Photo Signature Examples



CEGL005219 Rough leaf dogwood-(Smooth Sumac, Plum) Shrubland

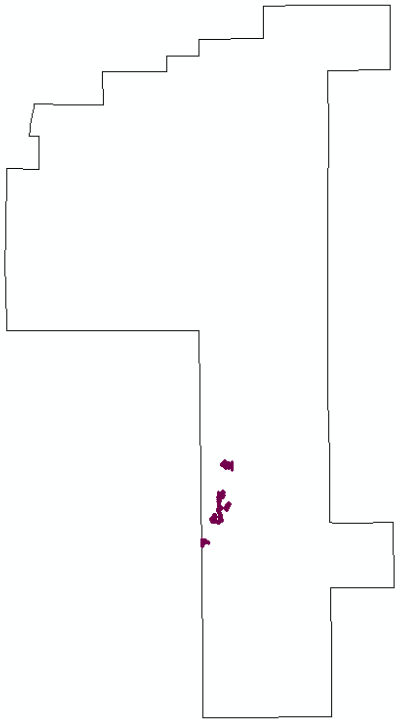
Cornus drummondii-(Rhus glabra, Prunus spp.) Shrubland

Dominant Vegetation

Rough leaf dogwood (Cornus drummondii)

Sandhill Plum (Prunus virginiana)

Range and Distribution

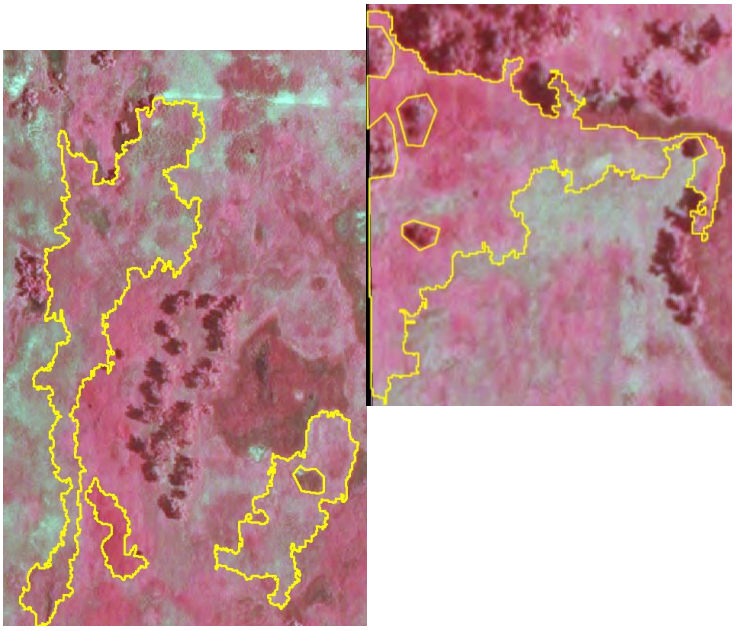


Description

This association is only found in the natural area of the refuge. Dogwood is intermixed with plum and surrounded by patches of native grassland vegetation. In the imagery this Shrubland is very difficult to distinguish from plum stands and could only be classified while on the ground.

Representation Ground Photo

Photo Signature Examples



QVR_25a Plum Shrubland

Prunus spp. Shrubland

Dominant Vegetation

American Plum (Prunus americana)

Sandhill Plum (Prunus virginiana)

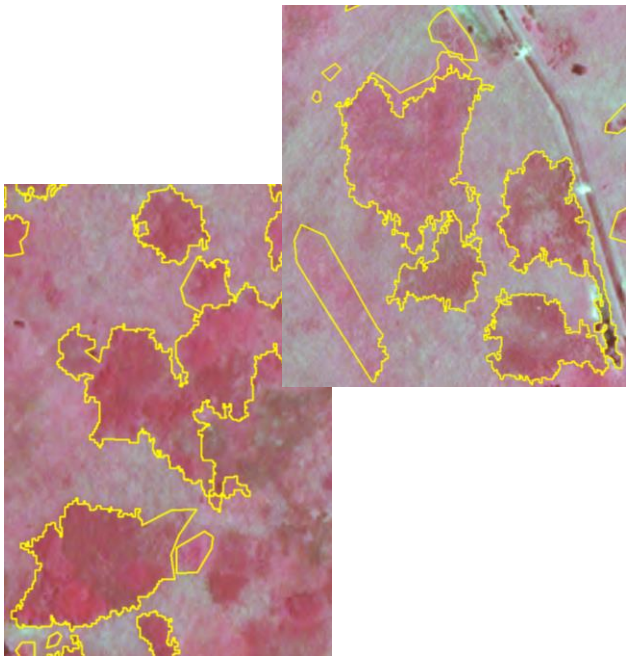
Range and Distribution

Description

This is an association that is dominated by either large patches of American or Sand hill Plum. The plum understory is either dominated by natives grassland plants like big bluestem, little bluestem, switchgrass, and Indiangrass or it has cheat grass in the understory which takes over when plum is removed. Plum is found in all upland areas in the refuge to various degrees. In imagery this association appears red and round with blurred edges.

Photo Signature Examples

Representation Ground Photo



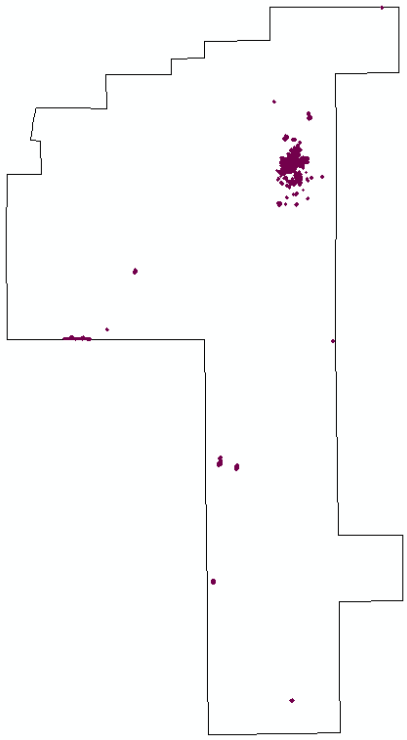
QVR_17a Fragrant Sumac Shrubland

Range and Distribution

Rhus aromatic Shrubland

Dominant Vegetation

Smooth Sumac (Rhus glabra)

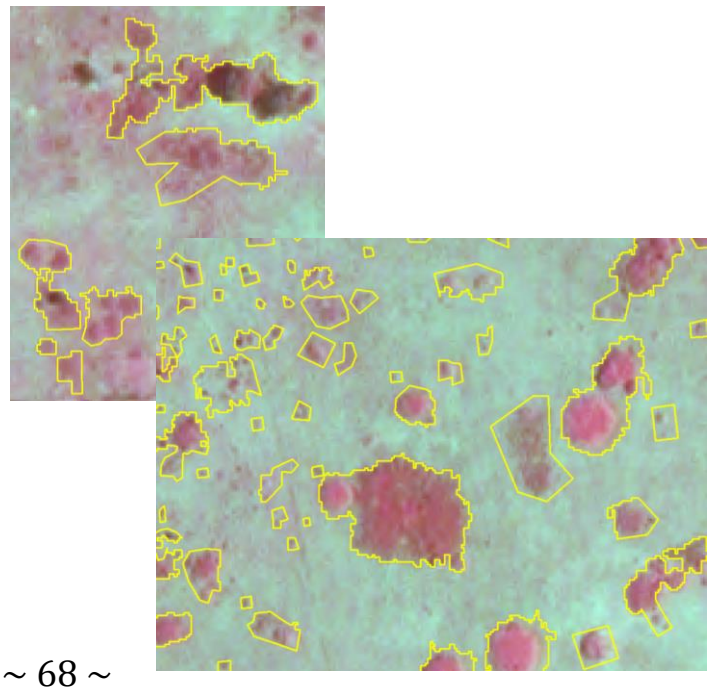


Description

Smooth Sumac occasionally occurs as a large monoculture patch. There are only a few significant patches found on the refuge. On the imagery this association appears as a dark bright red in grassland environments.

Representation Ground Photo

Photo Signature Examples



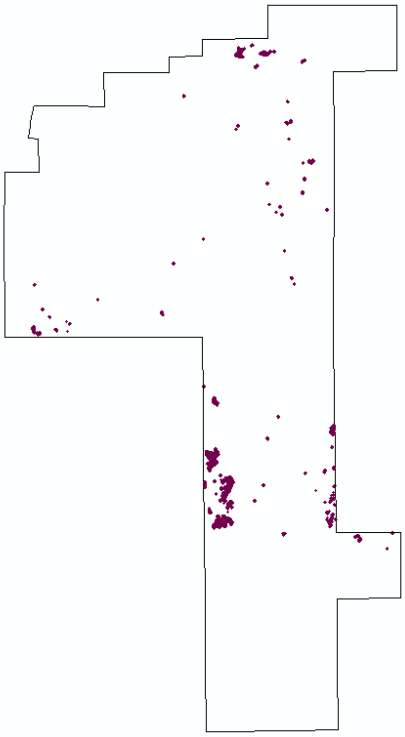
CEGL001203 Coyote Willow/ Mesic Graminoids Shrubland

Salix exigua/ Mesic Graminoids Shrubland

Dominant Vegetation

Coyote Willow (Salix exigua)

Range and Distribution

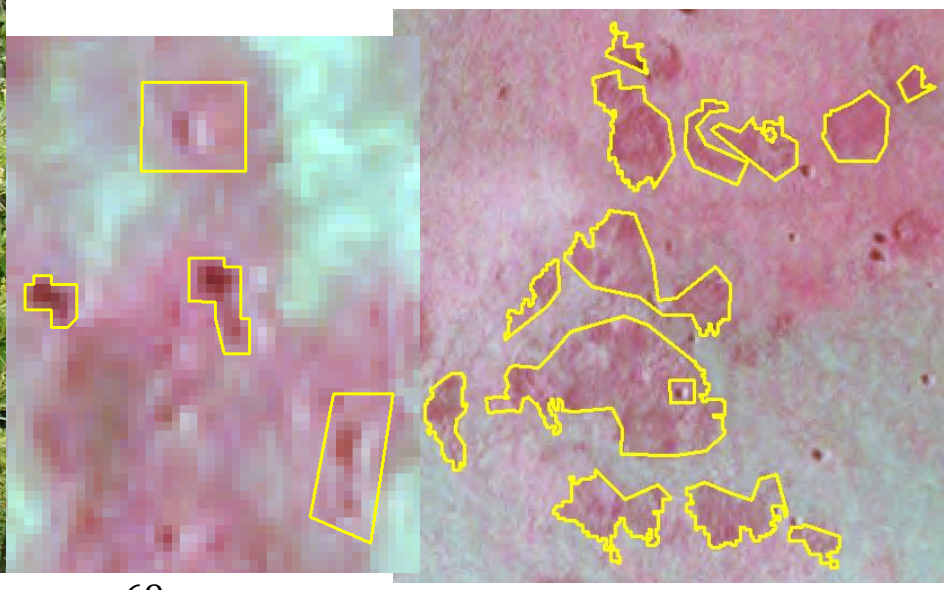


Description

Willow are scattered near consistent sources of water throughout the refuge. Willow tends to occur in small numbers especially along drainage ditches or creeks. They appear patchy pink with small white dots mixed together.

Representation Ground Photo

Photo Signature Examples



CEGL002024 Big Bluestem-Switchgrass-Saw tooth Sunflower

Range and Distribution

Herbaceous Vegetation

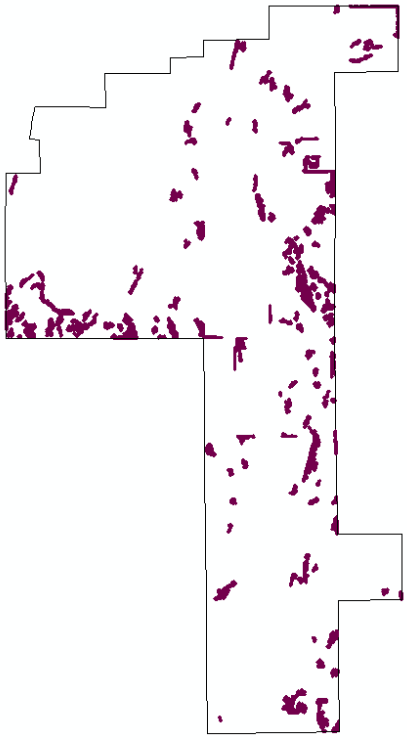
Andropogon gerardii-Panicum virgatum-Helianthus grosseserratus Herbaceous Vegetation

Dominant Vegetation

Big Bluestem (Andropogon gerardii)

Switchgrass (Panicum virgatum)

Indiangrass (Sorghastrum nutans)

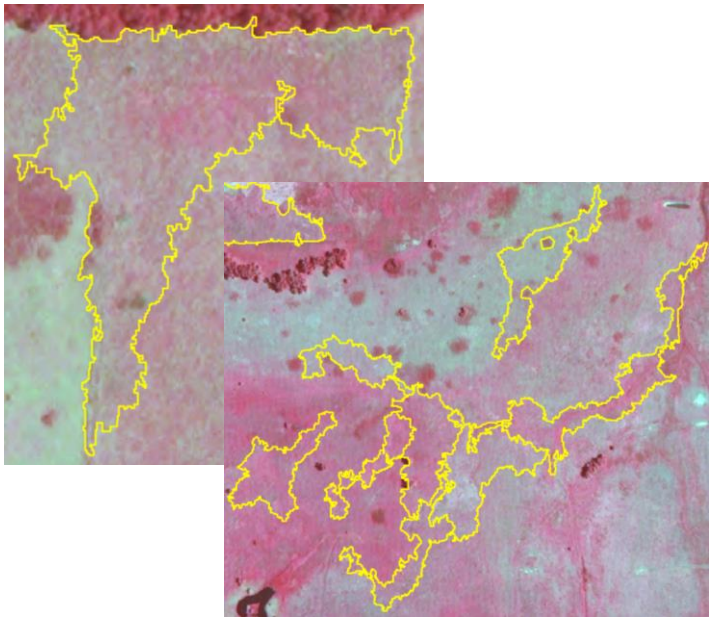


Description

This is the larer of the two big bluestem dominated grass associations. Big bluestem is often mixed with secondary upland grasses and lives in sandier soils. Some areas may also contain Prairie Cordgrass. I did not find sunflowers mixed into this assocation in th refuge. It is hard to differentiate between this association and other grassland associations.

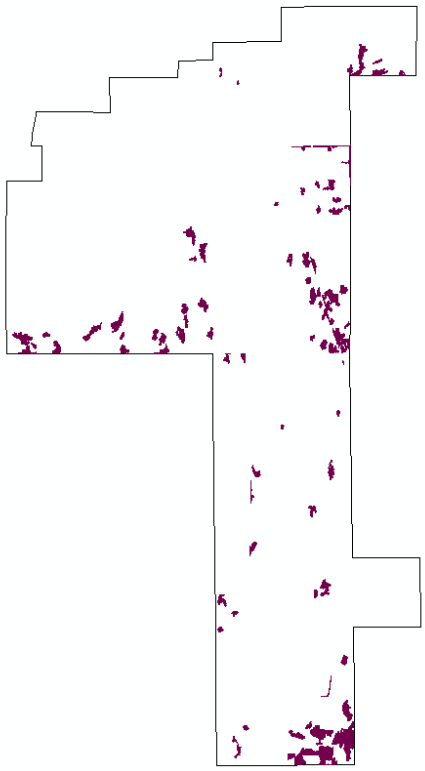
Representation Ground Photo

Photo Signature Examples



CEGL001464 Big Bluestem- Western Great Plains Herbaceous

Range and Distribution



Vegetation Andropogon gerardii-Sorghastrum nutans Western Great Plains Herbaceous Vegetation

Dominant Vegetation

Big Bluestem (Andropogon gerardii)

Indiangrass (Sorghastrum nutans)

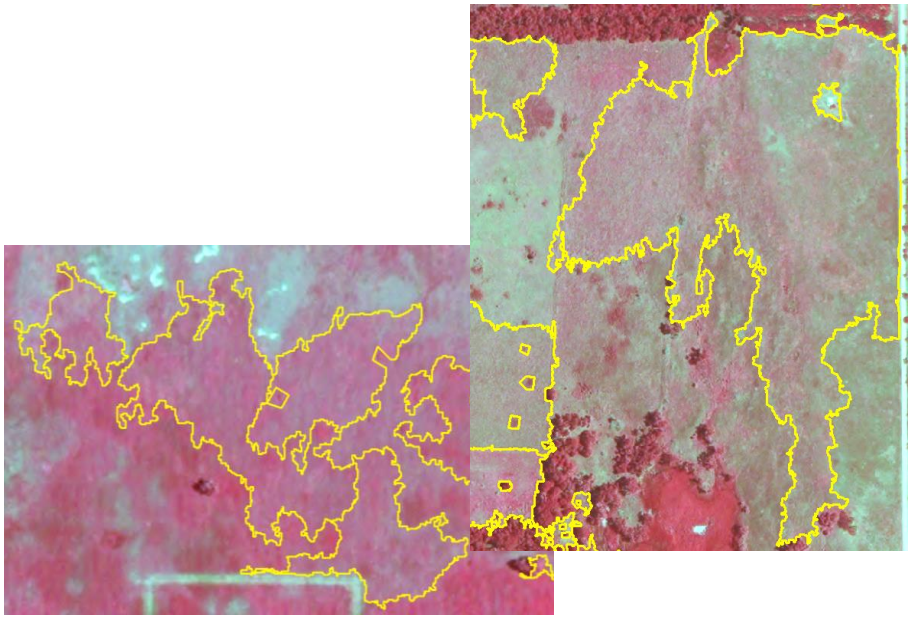
Switchgrass (Panicum virgatum)

Description

This is the smaller of the two big bluestem dominated grass associations. Big bluestem is often mixed with secondary upland grasses and lives in sandier soils. Some areas may also contain Prairie Cordgrass. It is hard to differentiate between this association and other grassland associations.

Photo Signature Examples

Representation Ground Photo



CEGL001467 Sand Bluestem-Long leaved reed grass

Herbaceous Vegetation

Andropogon hallii-Calamovilfa longifolia Herbaceous Vegetation

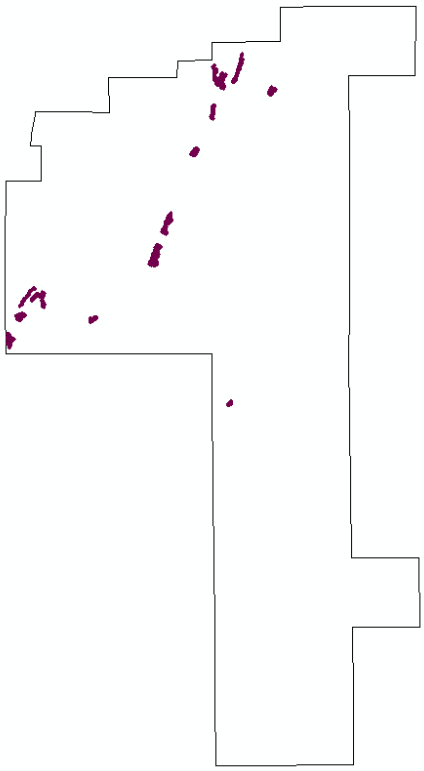
Dominant Vegetation

Sand Bluestem (Andropogon hallii)

Switchgrass (Panicum virgatum)

Indiangrass (Sorghastrum nutans)

Range and Distribution

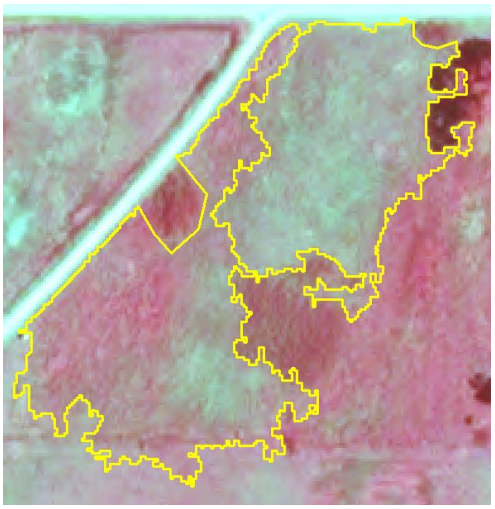


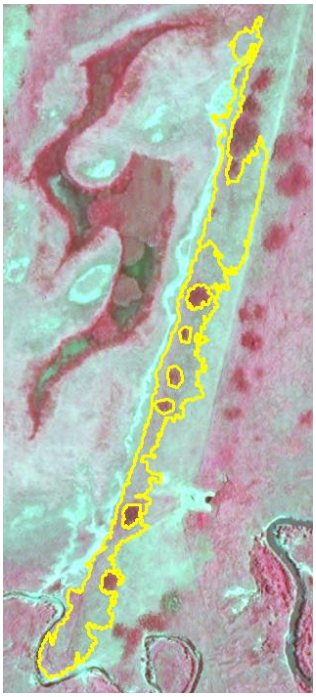
Description

Sand bluestem is found in in areas with sandy soils and tends to be found around sand dunes. Sand bluestem is often mixed with other upland grasess including swichgrass and Indiangrass. It is difficult to pick these areas out on th imagry because it is simalr to other grassland allainces.

Representation Ground Photo

Photo Signature Examples





CEGL002042 Saltgrass-(Squirrel-tail grass, Prairie Spear-grass,

Hair-grass Dropseed) Herbaceous Vegetation

Distichlis spicata- (Hordeum jubatum, Poa arida, Sporobolus airoides) Herbaceous Vegetation

Dominant Vegetation

Saltgrass (Distichlis spicata)

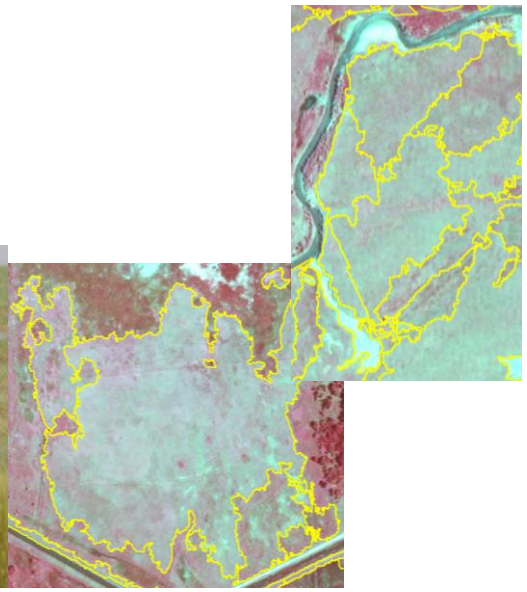
Range and Distribution

Description

This is the one of the most dominant associations on the refuge it is usually a monoculture but it can contain islands of upland grassland species. It occurs in high moisture areas around the refuge. Saltgrass shows up as either off white or light gray in color. It is often mixed with patches of bright white which is bare ground.

Photo Signature Examples

Representation Ground Photo

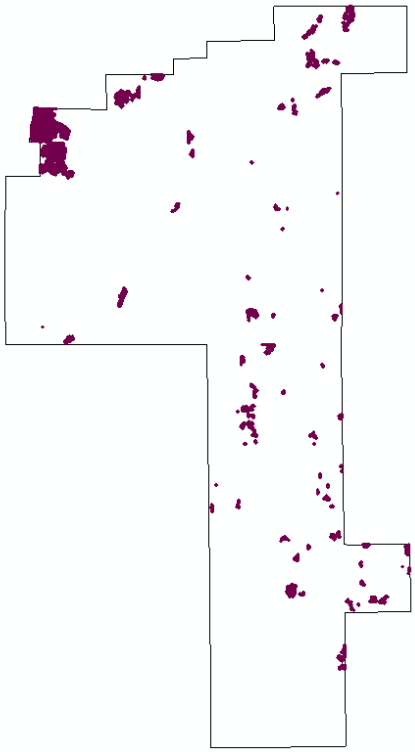


CEGL002259 Common Spikerush-(Flat stemmed Spike rush)

Range and Distribution

Herbaceous Vegetation

Eleocharis palustris-(Eleocharis compressa)-Leptochloa fusca ssp. Fascicularis Herbaceous Vegetation



Dominant Vegetation

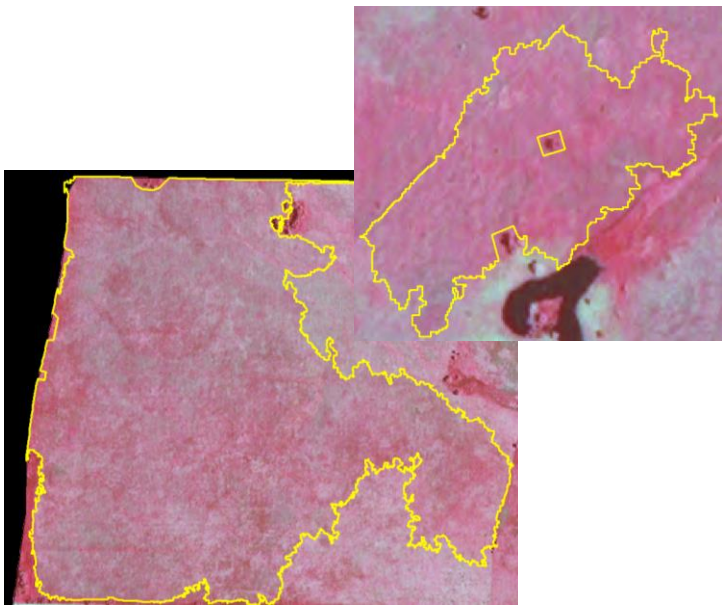
Eleocharis palustris (Common Spikerush)

Description

This association has a few small scattered sites throughout the Refuge except for the large patch in the Northwest corner. This plant occurs in saturated areas sometimes mixed with other wetland plants it's difficult to see this association on imagery but there are multiple shades of medium pink with a light brown or gray mixed together. It's easy to think these areas are an Eco tone on the map.

Representation Ground Photo

Photo Signature Examples



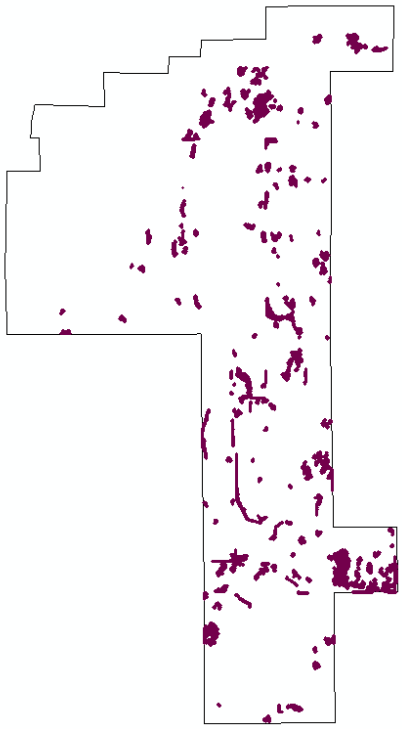
QVR_14a Switchgrass Herbaceous Vegetation

Range and Distribution

Panicum virgatum Herbaceous Vegetation

Dominant Vegetation

Switchgrass (Panicum virgatum)

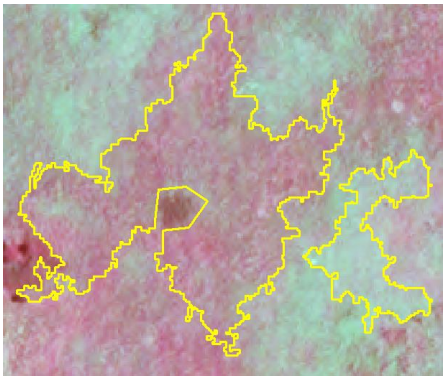


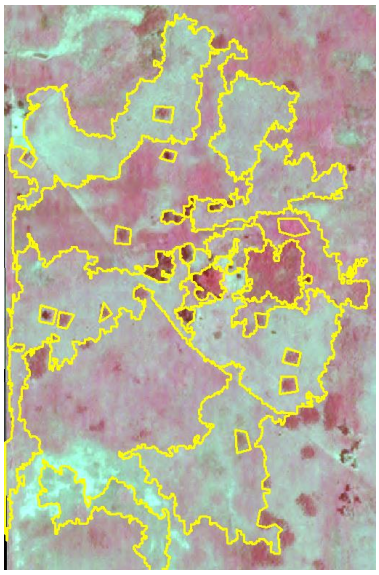
Description

This plant association only has switchgrass as the dominant grass and often times the area is also covered by a large number of forbs. These areas are somewhat disturbed compared to the surrounding area. Cheatgrass can also play a role in this association. It is difficult to tell this association from other grassland associations on the map.

Representation Ground Photo

Photo Signature Examples





QVR_14b Switchgrass-Indiangrass Herbaceous Vegetation

Panicum virgatum-Sorghastrum nutans Herbaceous Vegetation

Dominant Vegetation

Switchgrass (Panicum virgatum)

Indiangrass (Sorghastrum nutans)

Description

This is an association that is made up of secondary grass species because all the primary grasses are either not present or are present in less than 10% of the overall species composition. This area occurs alongside areas that possess dominant grass species. It is difficult to tell this grassland association from other grassland associations on the map.

Range and Distribution

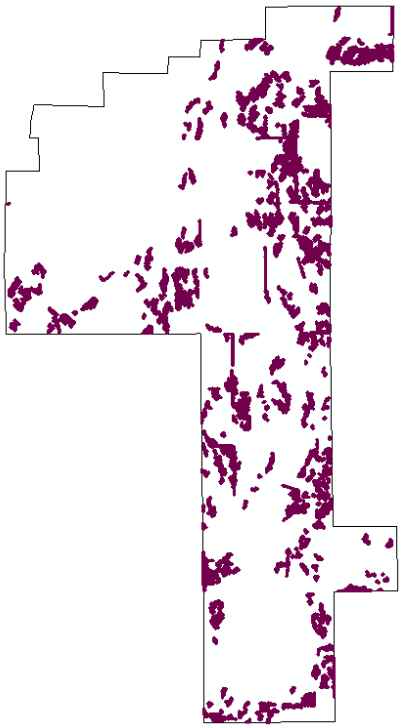
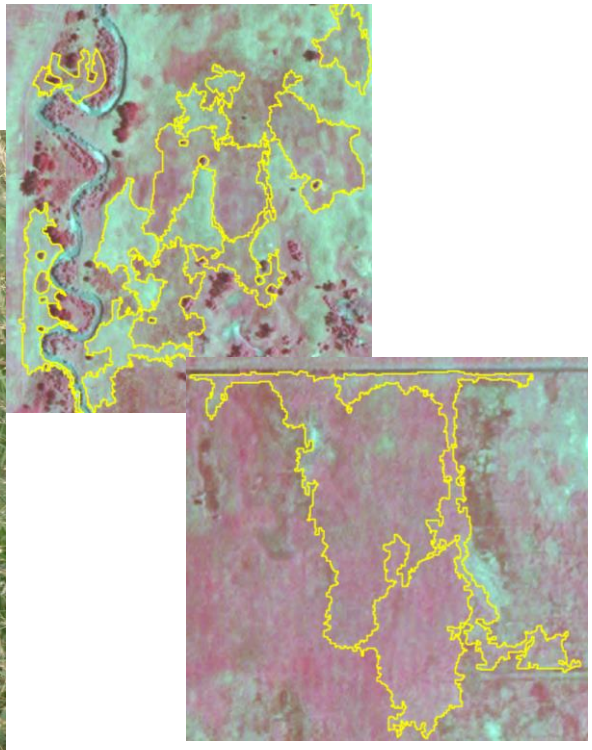


Photo Signature Examples



Representation Ground Photo

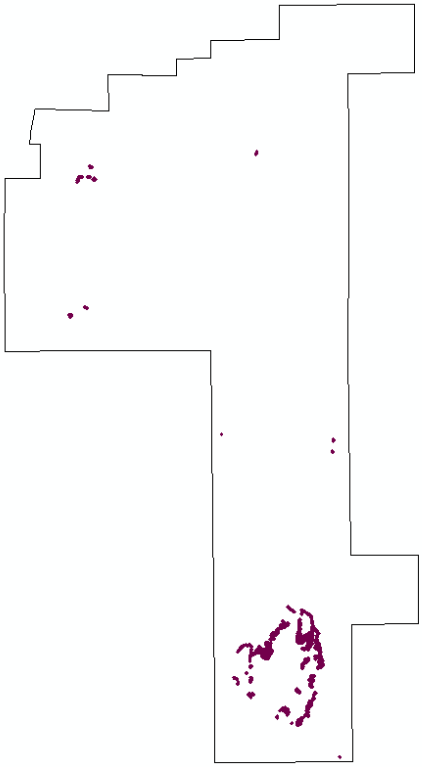
CEGL001475 Common Reed Western North America Temperate Semi-natural Herbaceous Vegetation

Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation

Dominant Vegetation

Common Reed (Phragmites australis)

Range and Distribution

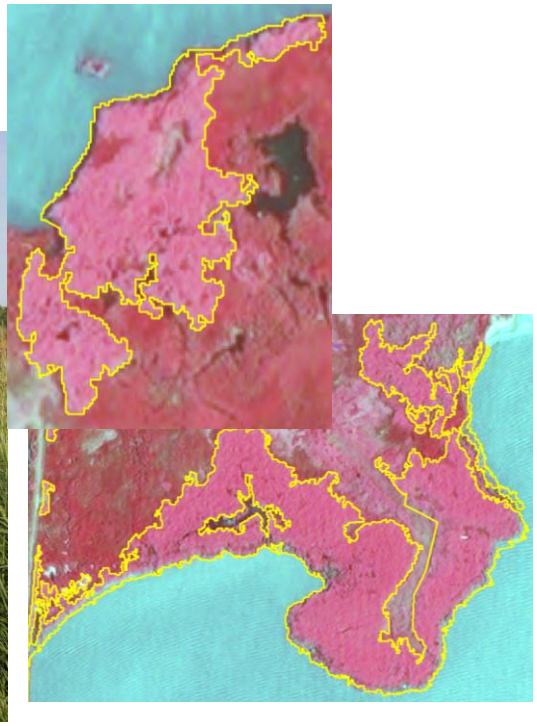


Description

This invasive association typically occurs as a monotypic stand around the little saltmarsh and in a few areas around the big salt marsh. It occurs in areas inundated by water for most of the year and it occurs on the edge of large water bodies. In the map imagery phragmites occurs as a solid bright pink.

Photo Signature Examples

Representation Ground Photo



CEGL001594 Little Bluestem- Gammagrass Western Great Plains

Herbaceous Vegetation

Schizachyrium scoparium-Bouteloua curtipendula Western Great Plains Herbaceous Vegetation

Dominant Vegetation

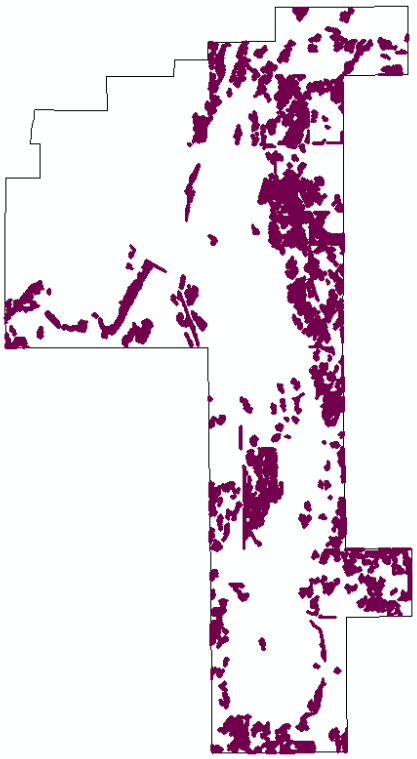
Little bluestem (Schizachyrium scoparium)

Switchgrass (Panicum virgatum)

Indiangrass (Sorghastrum nutans)

Big bluestem (Andropogon gerardii)

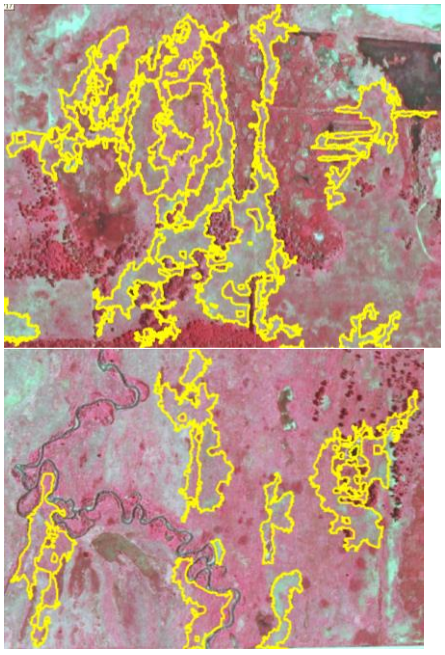
Range and Distribution



Description

Little bluestem is often mixed with Indiangrass and switchgrass and sometimes Big bluestem. There is very little Bouteloua curtipendula found on the refuge so this is an almost nonexistent component of the association. It is difficult to distinguish this vegetation type from other grassland vegetation type because they both contain many of the same plants.

Photo Signature Examples



Representation Ground Photo

CEGL001587 Three-square Herbaceous Vegetation

Schoenoplectus pungens Herbaceous Vegetation

Dominant Vegetation

Three-Square (Schoenoplectus pungens)

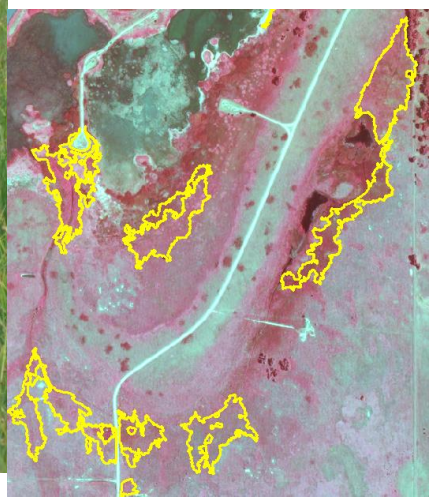
Range and Distribution

Description

This association occurs on the fringes of wet areas where it mixes with other wetland grasses. It tends to be a slightly higher elevations compared to saltgrass. On the imagery three-square is a medium pink and is splotchy with lighter vegetation like saltgrass in the mix.

Representation Ground Photo

Photo Signature Examples



QVR_16a Softstem Bulrush (Hardstem Bulrush) Semi-permanently Flooded Herbaceous Vegetation

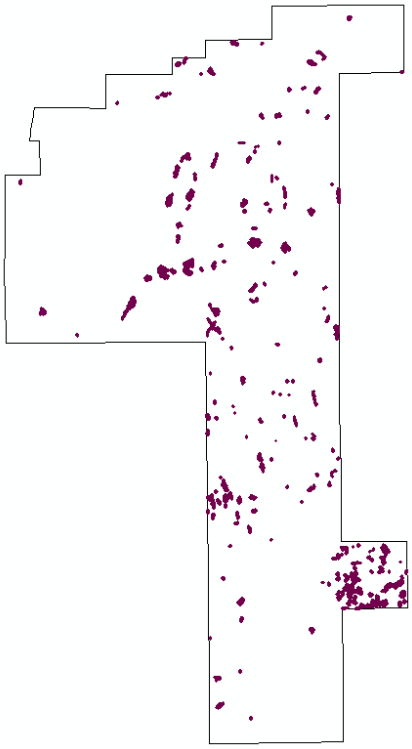
Schoenoplectus tabernaemontani (Schoenoplectus acutus) Semi-permanently Flooded Herbaceous Vegetation

Dominant Vegetation

Softstem Bulrush (Schoenoplectus tabernaemontani)

Hardstem Bulrush (Schoenoplectus acutus)

Range and Distribution

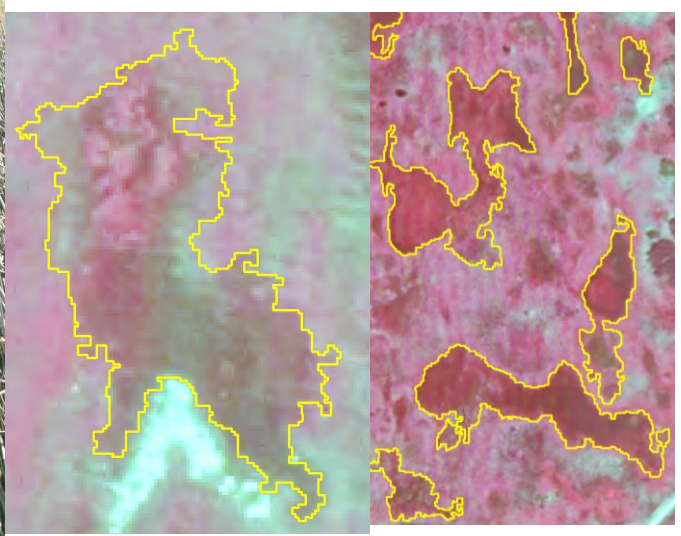


Description

This association occurs in shallow depressions that contain water at least part of the year that are filled with rushes. These areas are often small and isolated wetlands and they are made up of one type of bulrush. On the map these areas look like a dark red-brown sometimes with some small amounts of pink.

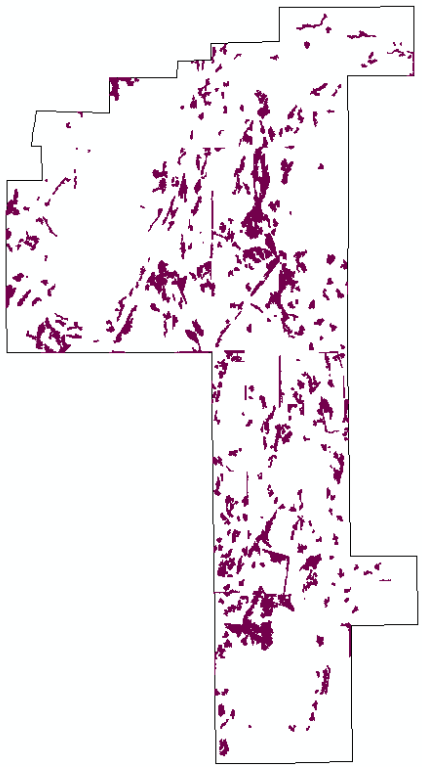
Representation Ground Photo

Photo Signature Examples



CEGL002223 Prairie Cordgrass-Spikerush-Sedge Herbaceous Vegetation **Range and Distribution**

Spartina pectinata-Eleocharis spp.-Carex spp. Herbaceous Vegetation



Dominant Vegetation

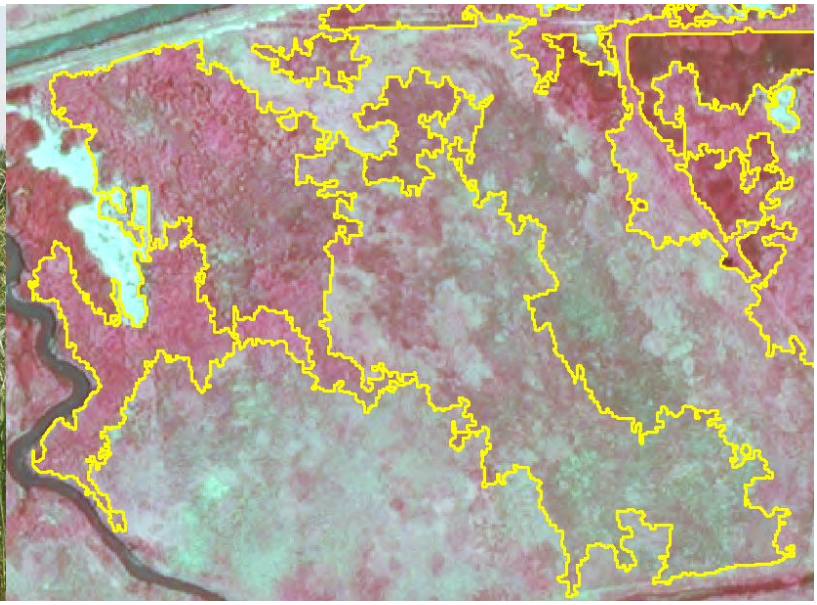
Prairie Cordgrass (Spartina pectinata)

Description

This association occurs on the edge of wet areas and may occur in areas that have small depression. Often times Prairie cord grass is mixed with grassland species like switchgrass and Indiangrass. On the map areas dominated by Prairie Cordgrass are a splotchy dark pink in color and a fairly solid pink when they are monotypic.

Representation Ground Photo

Photo Signature Examples



CEGL002389 Cattail Great Plains Herbaceous Vegetation

Typha spp. Great Plains Herbaceous Vegetation

Dominant Vegetation

Narrow-leaf Cattail (Typha angustifolia)

Broad-leaf Cattail (Typha latifolia)

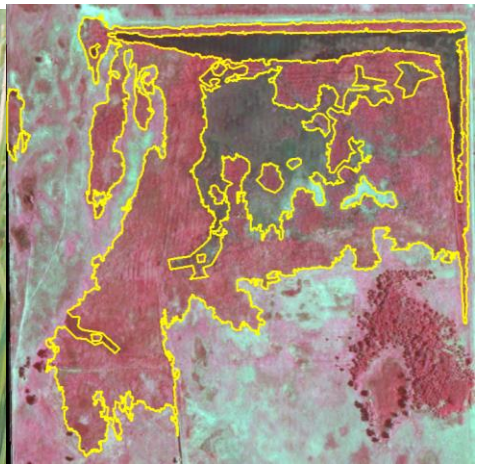
Range and Distribution

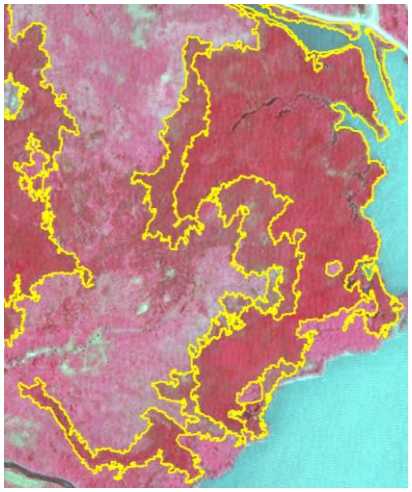
Description

This vegetation type is made up of at least 90% narrow-leaf cattail or broad-leaf cattail. It often occurs along flooded ditches and all the large bodies of water found at the refuge. There is more broadleaf cattail compared to narrow-leaf cattail on the refuge. Cattail appears bright red in circular clumps on the imagery regardless of the species of cattail.

Representation Ground Photo

Photo Signature Examples





CEGL002026 Softstem Bulrush-Cattail-(Bur-reed, Rush)

Herbaceous Vegetation

Schoenoplectus tabernaemontani-Typha spp.-(Sparganium spp., Juncus spp.) Herbaceous Vegetation

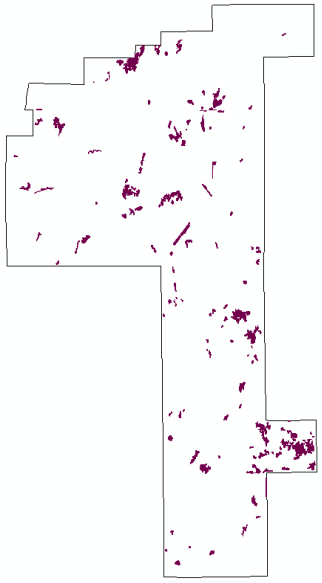
Dominant Vegetation

Softstem Bulrush (Schoenoplectus tabernaemontani)

Narrow-leaf Cattail (Typha angustifolia)

Broad-leaf Cattail (Typha latifolia)

Range and Distribution

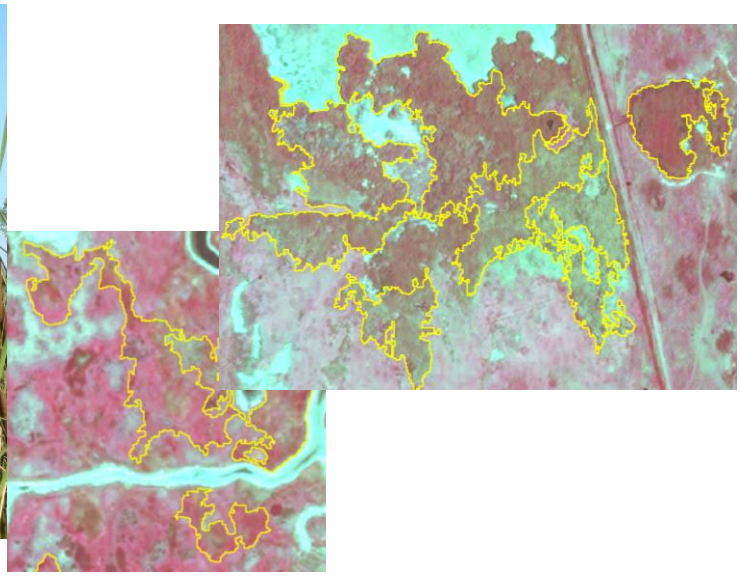


Description

This vegetation type is a mixture of Cattail (Narrow-leaf and Broadleaf), bulrush, and small amounts of other wetland vegetation. The Rush usually makes up at least 10% of the plant composition. This habitat type tends not to be directly next to large bodies of water like the areas that make up the water units. The these areas appear as a reddish brown on the map a mixture between the bright red of cattail and the very dark reddish brown of pure rushes.

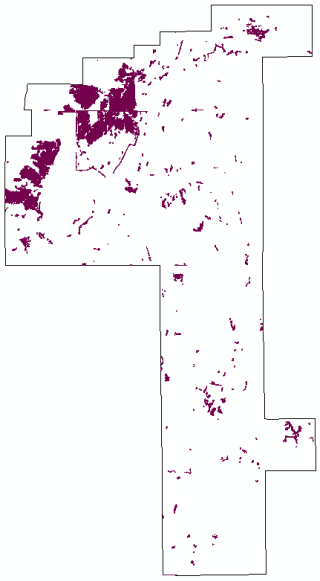
Representation Ground Photo

Photo Signature Examples



CEGL002049 Riverine Sand Flats-Bar Sparse Vegetation

Range and Distribution



Dominant Vegetation

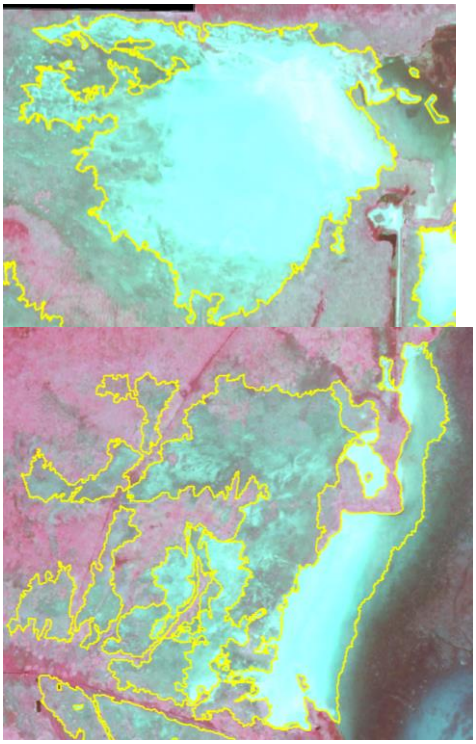
Saltgrass (Distichlis spicata)

Description

This Vegetation type is covered in water much of the year which limits vegetation to moist soil plants and small amounts of salt grass. On maps this area appears whitish blue sometimes with some gray mixed in due to lack of vegetation. This occurs in areas that are affected by fluctuating water levels due to management and natural processes.

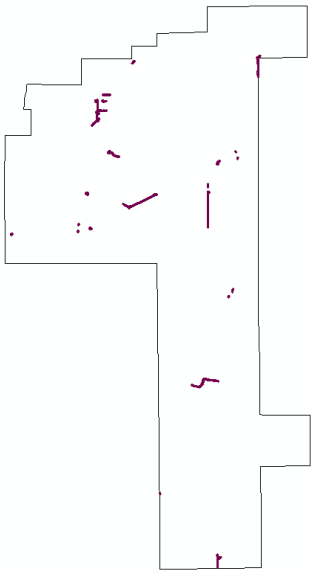
Photo Signature Examples

Representation Ground Photo



QVR_18a Bare Ground

Range and Distribution



Dominant Species

None

Description

This area type of the Refuge has no vegetation because of manmade disturbances that prevent vegetation from growing. On maps this area appears whitish blue due to lack of vegetation and they occur in areas that are not affected by water levels.

Representation Ground Photo

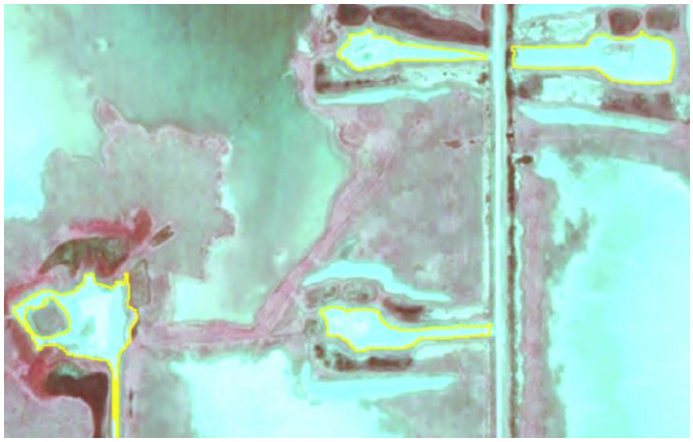
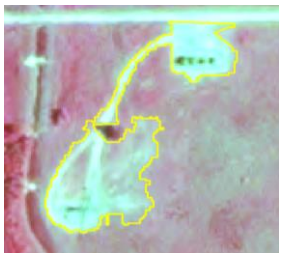
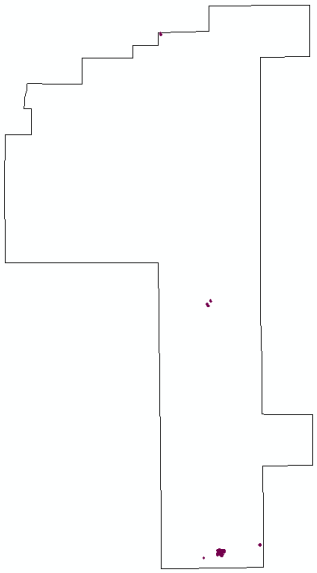


Photo Signature Examples



QVR_15a Buildings or Structures

Range and Distribution



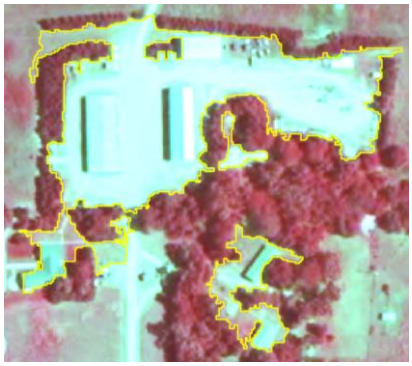
Dominant Species

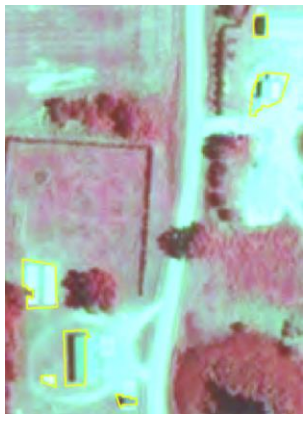
None

Description

This area type of the Refuge has no vegetation because there are buildings or other structures over areas where grass would exist. On maps this area appears whitish blue due to lack of vegetation and the shape of structures can be seen.

Photo Signature Examples

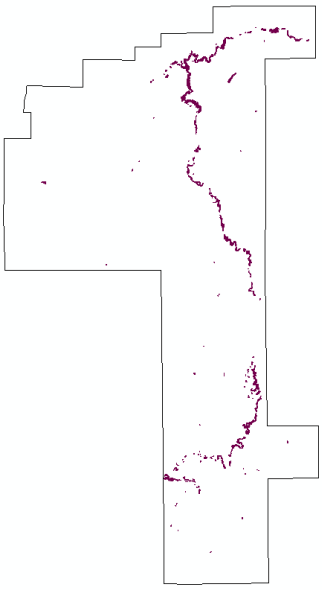




Representation Ground Photo

CEGL003114 Salt Cedar Temporarily Flooded Semi-natural Shrubland

Range and Distribution



Tamarix spp. Temporarily Flooded Semi-natural Shrubland

Dominant Species

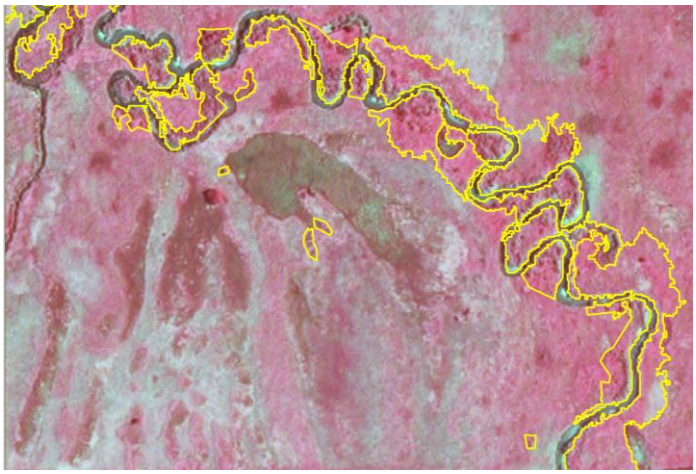
Salt Cedar (Tamarix spp.)

Description

This invasive community type is found mainly around large bodies of water and in ditches but it may also occur in wet meadows. It is usually around 4 feet tall and often occurs very close to other salt cedars. On aerial photos it appears as small clumped red dots surrounded by dark pink.

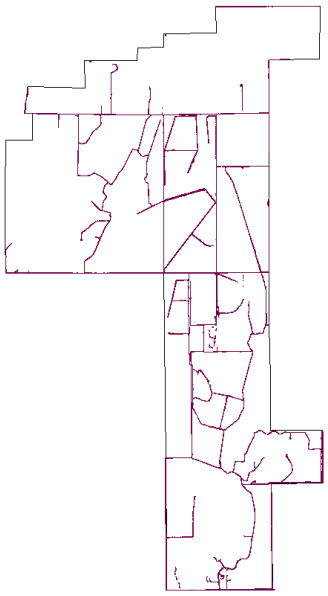
Representation Ground Photo

Photo Signature Examples



QVR 22A Roads

Range and Distribution



Dominant Species

None

Description

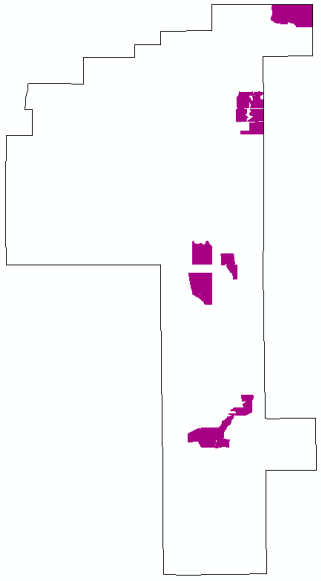
This area type of the Refuge has no vegetation because it is paved, or dirt roads that are frequently graded for vehicle use. On maps this area appears white due to lack of vegetation. It occurs in narrow strips and the areas are often interconnected.

Representation Ground Photo

Photo Signature Examples

QVR 9A Agriculture Area

Range and Distribution



Dominant Species

Milo (Sorghum ssp.)

Oats (Avena ssp.)

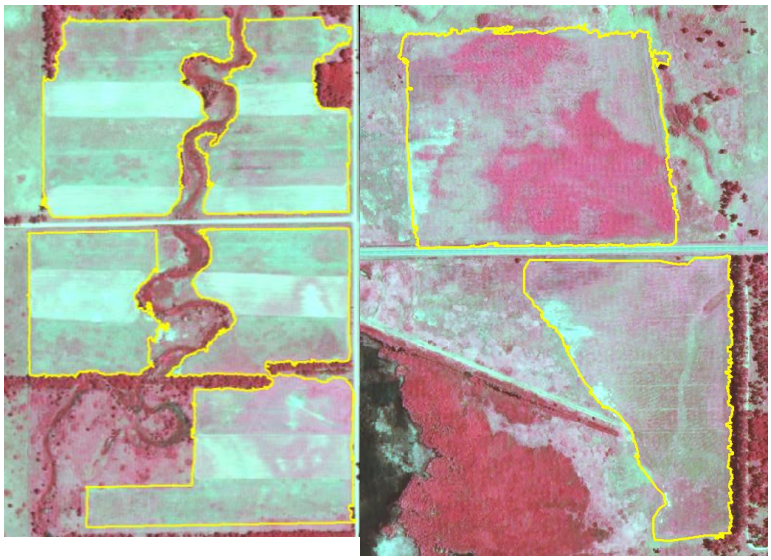
Wheat (*Triticum ssp.*)

Description

This vegetation type is found throughout the refuge and is used by cooperators of the refuge to plant milo, oats, and wheat. Some of these areas are in the process of returning to native vegetation but they still have many of the vegetation characteristics of cropland. These areas are banded in straight lines on the imagery or they are bare and contain coloration significantly different then the surrounding area because some areas are not planted every year. This information was taken from previously mapped agriculture areas.

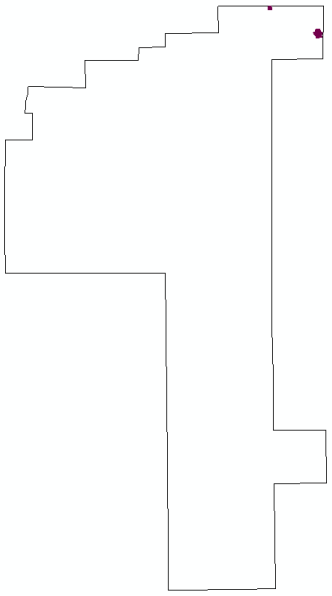
Representation Ground Photo

Photo Signature Examples



CECX005703 Black-tailed Prairie Dog Town Complex

Range and Distribution



Dominant species

Bull Thistle (Cirsium vulgare)

Buffalo gourd (Cucurbita foetidissima)

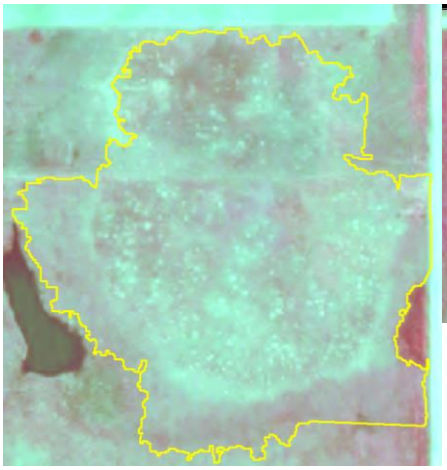
Devil's Claw (Proboscidea louisianica)

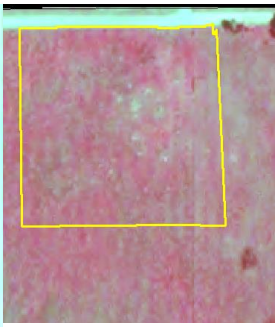
Description

This Vegetation type is found only in two locations in the East Salt Creek Section of the Refuge. These areas are covered with numerous invasive plants and there are many areas that lack vegetation. Only vegetation with spines is abundant (*Cirsium vulgare*, *Cucurbita foetidissima*, and *Proboscidea louisianica*) in this area due to other plants being clipped by prairie dogs to maintain line of site around the colony. The imagery contains large clumps of holes which appear as white dots on the imagery. These areas were mapped by on foot to the full extent of the area.

Representation Ground Photo

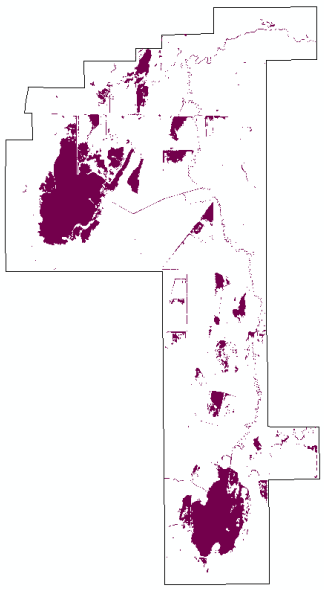
Photo Signature Examples





QVR 10 Water

Range and Distribution



Dominant Species

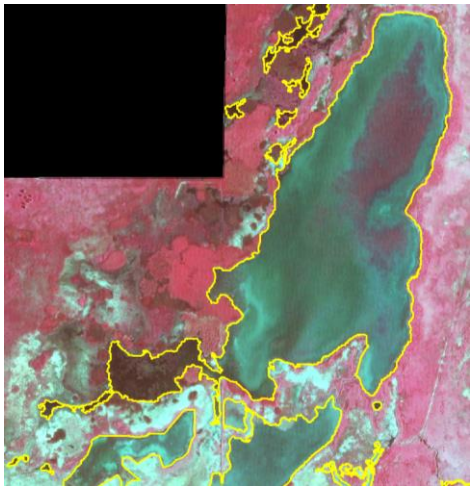
Polygonum spp.

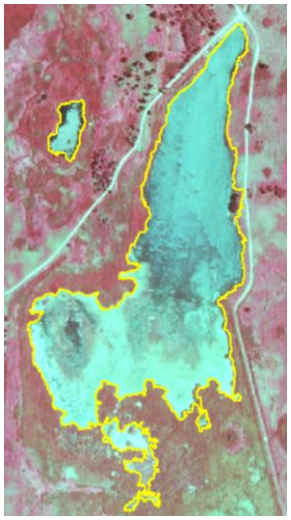
Description

This type is found all over the refuge in both natural and manmade water areas. It contains Polygonum spp. in many water sources for at least part of the year except little salt marsh. These water areas also provide habitat for plants during period of draw down. In the imagery water appears as a dark brown color, a medium blue or a light blue in contrast to the shades of red and pink found on the rest of the imagery. The areas of water on the refuge may change yearly as result of drought, drawdown, or filling of units. Water is marked by its location in 2008 when the imagery was flown.

Photo Signature Examples

Representation Ground Photo





QVR 29a Maclura pomifera Woodland

Osage-Orange Woodland

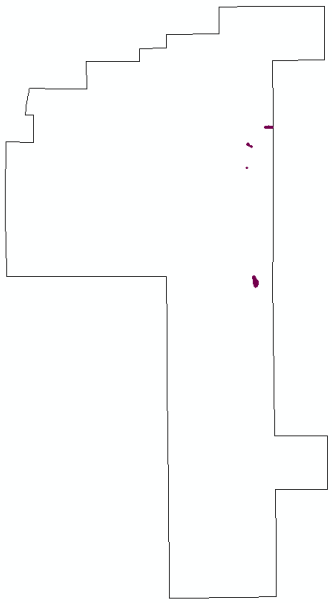
Dominant Species

Maclura pomifera

Description

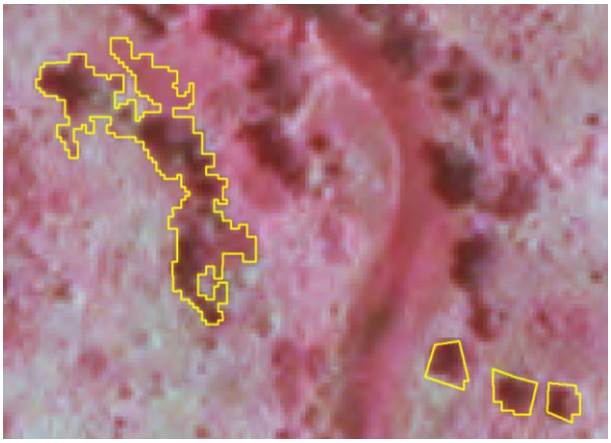
This association occurs in tree stands on the refuge. It often occurs in rows from past plantings. Stands can be dense but often are encroached by other trees. The infrared shows trees in rows it can vary in color because it is usually mixed with pother species of trees.

Range and Distribution



Representation Ground Photo

Photo Signature Examples



QVR 27a Bromus tectorum Semi-natural Herbaceous vegetation

Cheat grass Semi-natural Herbaceous Vegetation

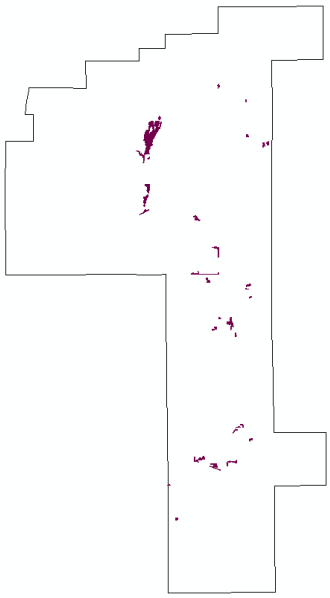
Dominant Species

Bromus tectorum

Description

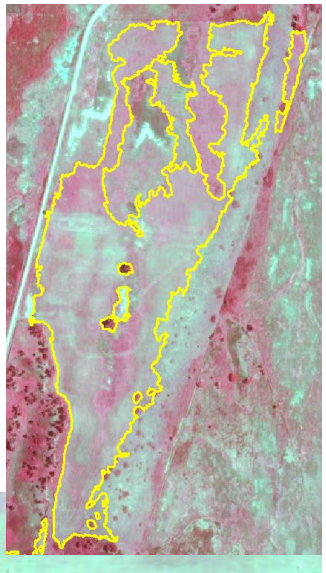
This association is found in many areas around the Refuge in small amounts but if an area has a significant disturbance then it can become the dominant grass type. Many times it occurs near areas that are disturbed by agriculture of area disturbed by mechanical removal. The signature tends to have a medium pink color with lighter patches of color mixed in. This is not to be confused with areas with bright pink patches which are typically forb dominated

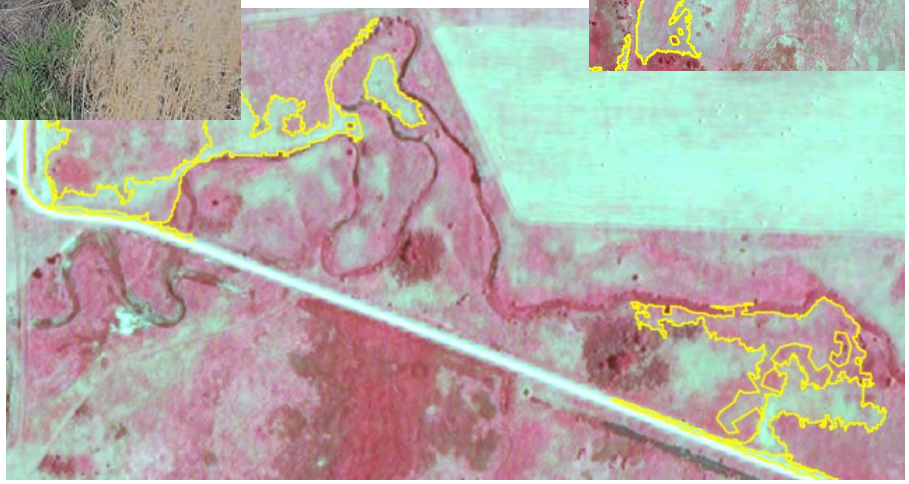
Range and Distribution



Representation Ground Photo

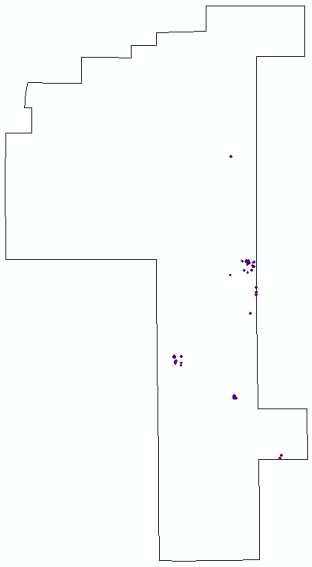
Photo Signature Examples





QVR 28a Fraxinus pennsylvanica Forest

Range and Distribution



Green Ash Forest

Dominant species

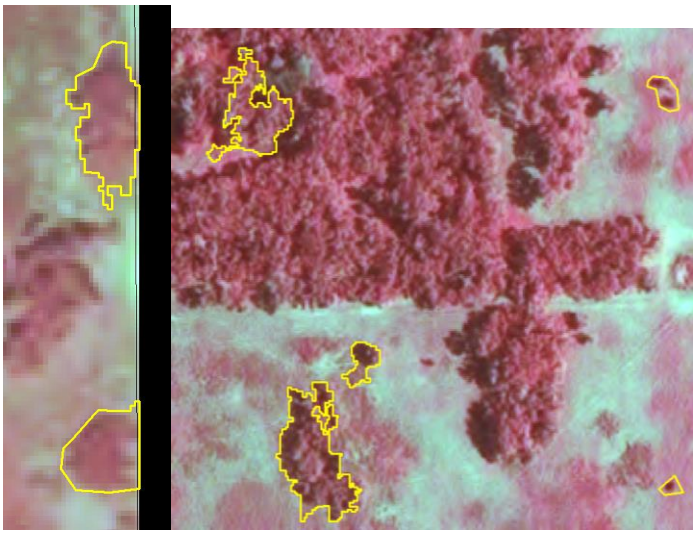
Fraxinus pennsylvanica

Description

This association occurs in small stands mainly in the central part of the refuge. This association is typically found mixed in with other tree alliances in mixed tree groves. Occasionally they occur in small bunches not associated with tree groves. The infrared for community is very difficult to distinguish from other mixed tree stands but depending on the density it can range from a lighter pink with a poorly defined canopy to a medium pink with a textured canopy.

Representation Ground Photo

Photo Signature Examples



QVR 31a Urochloa mutica Herbaceous Vegetation

Buffalo grass Herbaceous Vegetation

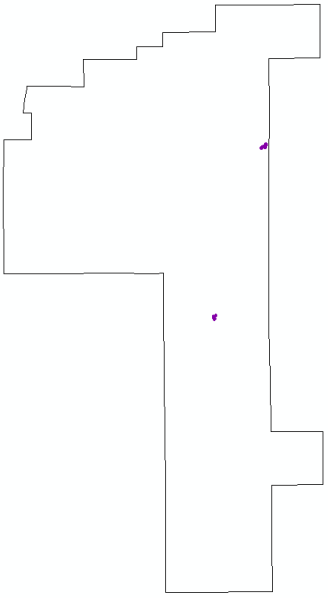
Dominant Species

Urochloa mutica

Description

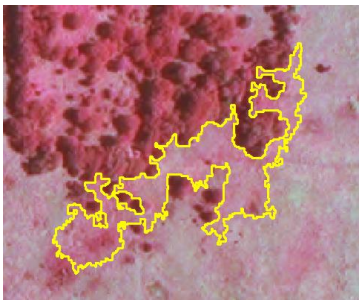
This association occurs in 2 small stands located near the bunk house and in Tree stand in Dead Horse Slough. It's founded in areas where the grass was planted my management or in areas where there is well drained soil. The infrared for community is difficult to pick out on th imagry because it is simalr to other grassland allainces in color.

Range and Distribution



Representation Ground Photo

Photo Signature Examples



QVR 31a Sapindus saponaria Woodland

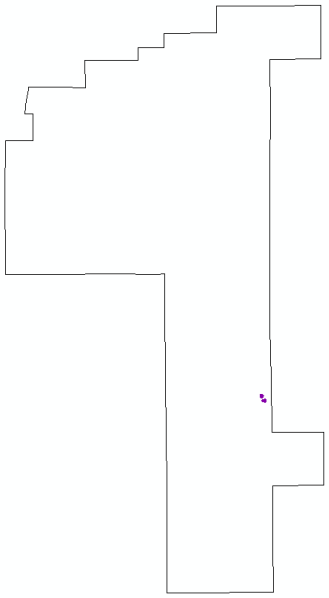
Range and Distribution

Soapberry Woodland

Dominant species

Sapindus saponaria

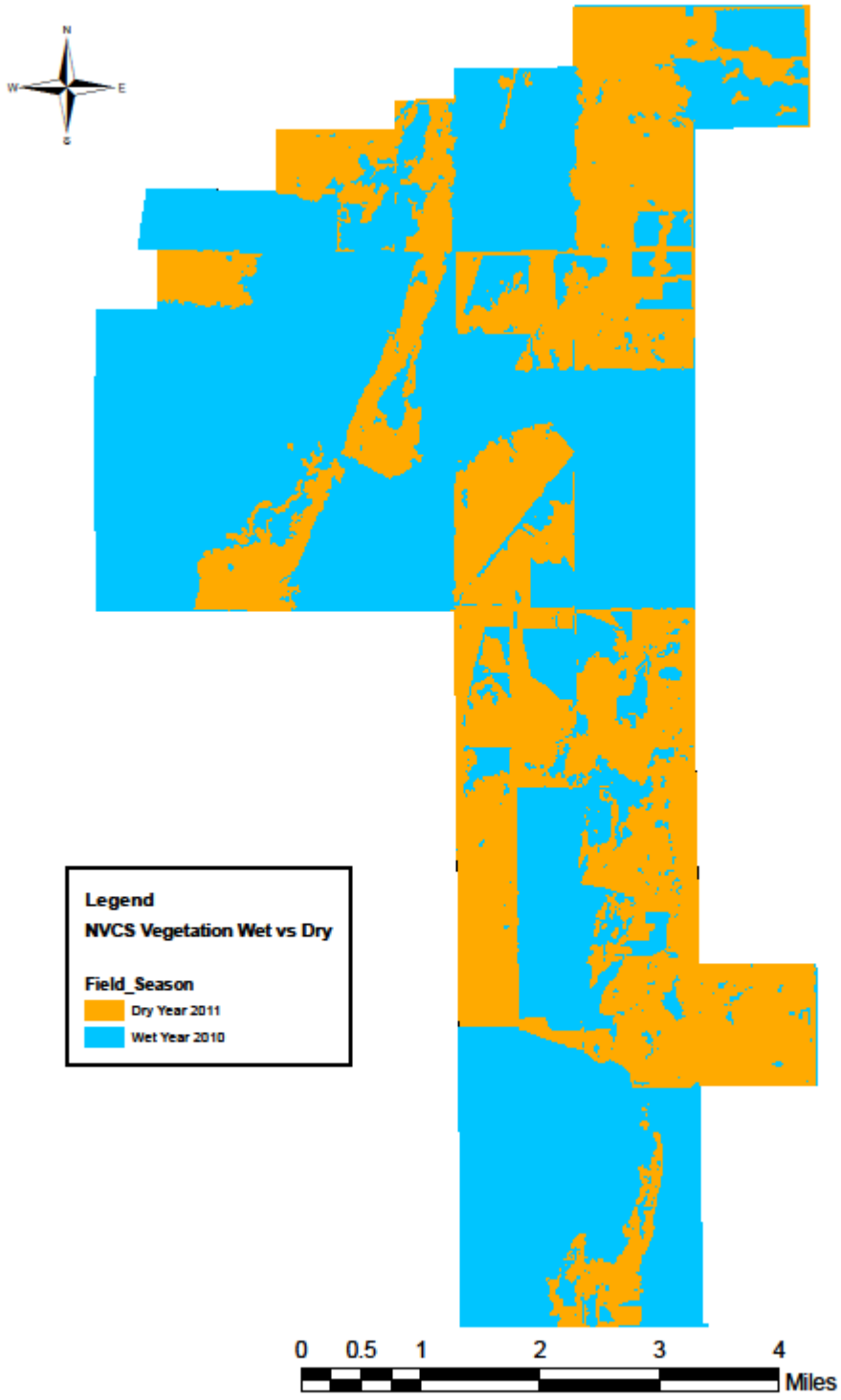
This association occurs in 2 small stands located along Rattle Snake Creek bordering along the 12b Darrynane Sandhill units. This association is typically found along streams. The infrared for community is similar to tamarisk but the tree canopy is made up of denser individual trees and is a darker pink in color.



Representation Ground Photo

Photo Signature Examples

Appendix G: Verifying map accuracy in wet and dry years.



Appendix H: Vegetation classification names and codes used to facilitate data entry in GIS.

Letter Code	Common Name	*Scientific Name*	System	NVCS Class	Height Class	NVCS Subclass	NVCS Group	NVCS Subgroup	NVCS Formation	NVCS Alliance Code	NVCS Alliance	NVCS Association Code	NVCS Association
Trees													
AE	American Elm	*Ulmus Americana*	T	W	>5 M	NA	NA	NA	NA	QVR_23	*Ulmus Americana* Woodland Alliance	QVR_23a	*Ulmus Americana* Woodland
BE	Box Elder	*Acer Negundo*	T	W	>5 M	NA	NA	NA	NA	QVR_13	*Acer Negundo* Woodland Alliance	QVR_13a	*Acer Negundo Woodland*
CA	Northern Catalpa	*Catalpa speciosa*	T	F	>5 M	I.B	I.B.2	N	I.B.2.N.d	QVR_1	*Catalpa speciosa* Forest Alliance	QVR_1a	*Catalpa speciosa* Forest
CW	Cottonwood	*Populus deltoides*	A	F	>5 M	I.B	I.B.2	N	I.B.2.N.d	A.290	*Populus deltoides* Temporarily Flooded Forest Alliance	CEGL002018	*Populus deltoides*-Salix nigra Forest
GA	Green Ash	*Fraxinus pennsylvanica*	T	W	>5 M	NA	NA	NA	NA	QVR_28	*Fraxinus pennsylvanica* Forest Alliance	QVR_28a	*Fraxinus pennsylvanica Forest*
HB	Hackberry	*Celtis occidentalis*	T	W	>5 M	NA	NA	NA	NA	QVR_20	*Celtis occidentalis* Woodland Alliance	QVR_20a	*Celtis occidentalis* Woodland
KC	Kentucky Coffee-tree	*Gymnocladus dioicus*	T	F	>5 M	NA	NA	NA	NA	QVR_5	*Gymnocladus dioicus* Forest Alliance	QVR_5a	*Gymnocladus dioicus* Forest
L	Locust	*Robinia pseudoacacia /Gleditsia triacanthos*	T	W	>5 M	II.B	II.B.2	N	II.B.2.N.a	QVR_26	*Robinia pseudoacacia /Gleditsia triacanthos* Forest Alliance	QVR_26a	*Robinia pseudoacacia/Gleditsia triacanthos Forest*
M	Mulberry	*Morus rubra*	T	W	>5 M	NA	NA	NA	NA	QVR_12	*Morus rubra* Woodland Alliance	QVR_12a	*Morus rubra* Woodland
OB	Soapberry	*Sapindus saponaria*	T	W	>5 M	NA	NA	NA	NA	QVR_30	*Sapindus saponaria* Woodland Alliance	QVR_30a	*Sapindus saponaria* Woodland
0O	Osage Orange	*Maclura pomifera*	T	W	>5 M	NA	NA	NA	NA	QVR_29	*Maclura pomifera* Woodland Alliance	QVR_29a	*Maclura pomifera Woodland*
RC	Red Cedar	*Juniperus virginiana*	T	F	>5 M	I.A	I.A.8	N	I.A.8.N.c	A.137	*Juniperus virginiana Semi-natural Forest Alliance*	CEGL002593	*Juniperus virginiana Semi-natural Forest*
RO	Russian Olive	*Elaeagnus angustifolia*	A	W	>5 M	NA	NA	NA	NA	QVR_8	*Elaeagnus angustifolia Woodland Alliance*	QVR_8a	*Elaeagnus angustifolia Woodland*
SE	Siberian Elm	*Ulmus pumila*	T	W	>5 M	NA	NA	NA	NA	QVR_6	*Ulmus pumila Woodland Alliance*	QVR_6a	*Ulmus pumila Woodland*

Letter Code	Common Name	*Scientific Name*	System	NVCS Class	Height Class	NVCS Subclass	NVCS Group	NVCS Subgroup	NVCS Formation	NVCS Alliance Code	NVCS Alliance	NVCS Association Code	NVCS Association
TH	Tree of Heaven	*Ailanthus altissima*	T	F	>5 M	I.B	I.B.2	N	I.B.2.N.a	A.221	*Ailanthus altissima Forest Alliance*	CEGL007191	*Ailanthus altissima Forest*
Shrubland													
DW	Rough leaf Dogwood	*Cornus drummondii*	T	S	0.50-5M	III.B	III.B.2	N	III.B.2.N.a	A.3558	*Cornus drummondii Shrubland Alliance*	CEGL005219	*Cornus drummondii- (Rhus glabra, Prunus spp.) Shrubland*
P	Plum	*Prunus spp.*	T	S	0.50-5M	III.B	III.B.2	N	III.B.2.N.a	QVR_25	*Prunus spp. Shrubland Alliance*	QVR_25a	*Prunus spp. Shrubland*
SC	Salt Cedar	*Tamarix spp.*	A	S	0.50-5M	III.A	III.A.4	N	III.A.4.N.c	A.842	*Tamarix spp. Semi-natural Temporarily Flooded Shrubland Alliance*	CEGL003114	*Tamarix spp. Semi-natural Temporarily Flooded Shrubland*
SU	Sumac	*Rhus aromatica*	T	S	0.50-5M	NA	NA	NA	NA	QVR_17	*Rhus glabra Shrubland Alliance*	QVR_17a	*Rhus glabra Shrubland*
W or Wi	Willow	*Salix (exigua, interior)*	A	S	0.50-5M	III.B	III.B.2	N	III.B.2.N.d	A.947	*Salix (exigua, interior) Temporarily Flooded Shrubland Alliance*	CEGL001203	*Salix exigua / Mesic Graminoids Shrubland*
Herbaceous													
AG	Agriculture	*NA*	NA	NA	NA	NA	NA	NA	NA	QVR_9	*Agriculture Vegetation Alliance*	QVR_9a	*Agriculture Vegetation*
BBS & SW	Big Bluestem- Switchgrass	*Andropogon gerardii - Panicum virgatum*	T	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.a	A. 1191	*Andropogon gerardii - (Calamagrostis canadensis, Panicum virgatum) Herbaceous Alliance*	CEGL002024	*Andropogon gerardii - Panicum virgatum - Helianthus grosseserratus Herbaceous Vegetation*
BBS & IG	Big Bluestem-Indiangrass	*Andropogon gerardii - Sorghastrum nutans*	T	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.a	A. 1192	*Andropogon gerardii - (Sorghastrum nutans) Herbaceous Alliance*	CEGL001464	*Andropogon gerardii - Sorghastrum nutans Western Great Plains Herbaceous Vegetation*
SR	Common Spike-rush	*Eleocharis palustris*	A	H	<0.5	V.A	V.A.5	N	V.A.5.N.j	A. 1342	*Eleocharis palustris Temporarily Flooded Herbaceous Alliance*	CEGL002259	*Eleocharis palustris - (Eleocharis compressa) - Leptochloa fusca ssp. fascicularis Herbaceous Vegetation*
Phrag	Common Reed	*Phragmites australis*	A	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.l	A.1431	*Phragmites australis Semi-permanently Flooded Herbaceous Alliance*	CEGL001475	*Phragmites australis Western North America Temperate Semi-natural Herbaceous Vegetation*
PD	Prairie Dog Towns	*NA*	NA	NA	NA	NA	NA	NA	NA	A.XXXX	*Grassland Complex Herbaceous Alliance*	CECX005703	*Black tailed Prairie Dog Town Grassland Complex*
BG	Bare Ground	*NA*	NA	NA	NA	NA	NA	NA	NA	QVR_18	*Bare Ground Alliance*	QVR_18a	*Bare Ground Vegetation*
BG	Sand Flats	*NA*	A	H	<0.5	VII.C	VII.C.2	N	VII.C.2.N.c	A. 1754	*Sand Flats Temporarily Flooded Sparsely Vegetated Alliance*	CEGL002044	*Riverine Sand Flats- Bar Sparse Vegetation*

Letter Code	Common Name	*Scientific Name*	System	NVCS Class	Height Class	NVCS Subclass	NVCS Group	NVCS Subgroup	NVCS Formation	NVCS Alliance Code	NVCS Alliance	NVCS Association Code	NVCS Association
SW IG	Switchgrass -Indiangrass	*Panicum virgatum-Sorghastrum nutans*	T	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.a	QVR_14	*Panicum virgatum Alliance*	QVR_14b	*Panicum virgatum- Sorghastrum nutans Herbaceous Vegetation*
SW	Switchgrass	*Panicum virgatum*	T	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.a	QVR_14	*Panicum virgatum Alliance*	QVR_14a	*Panicum virgatum Herbaceous Vegetation*
PC	Prairie Cordgrass	*Spartina pectinata*	A	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.j	A. 1347	*Spartina pectinata Temporarily Flooded Herbaceous Alliance*	CEGL002223	*Spartina Pectinata - Eleocharis spp. - Carex spp. Herbaceous Vegetation*
R	Rush	*Schoenoplectus tabernaemontani - (Schoenoplectus acutus)*	A	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.l	QVR_16	*Schoenoplectus tabernaemontani (Schoenoplectus acutus) Semi-permanently Flooded Herbaceous Alliance*	QVR_16a	*Schoenoplectus tabernaemontani (Schoenoplectus acutus) Semi-permanently Flooded Herbaceous Vegetation*
CT	Cattail	*Typha (angustifolia, latifolia)*	A	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.l	A. 1436	*Typha (angustifolia, latifolia) - (Schoenoplectus spp.) Semi-permanently Flooded Herbaceous Alliance*	CEGL002389	*Typha spp. Great Plains Herbaceous Vegetation*
CT R	Cattail-Rush	*Typha spp. - Schoenoplectus spp.,*	A	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.k	A. 1394	*Typha spp. - (Schoenoplectus spp., Juncus spp.) Seasonally Flooded Herbaceous Alliance*	CEGL002026	*Schoenoplectus tabernaemontani - Typha spp. - (Sparganium spp., Juncus spp.) Herbaceous Vegetation*
SA	Saltgrass	*Distichlis spicata*	A	H	<0.5	V.A	V.A.5	N	V.A.5.N.j	A. 1341	*Distichlis spicata - (Hordeum jubatum) Temporarily Flooded Herbaceous Alliance*	CEGL002042	*Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides) Herbaceous Vegetation*
LBS	Little Bluestem	*Schizachyrium scoparium*	T	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.a	A. 1225	*Schizachyrium scoparium - Bouteloua curtipendula Herbaceous Alliance*	CEGL001594	*Schizachyrium scoparium - Bouteloua curtipendula Western Great Plains Herbaceous Vegetation*
SBS	Sand Bluestem	*Andropogon hallii*	T	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.a	A. 1193	*Andropogon hallii Herbaceous Alliance*	CEGL001467	*Andropogon hallii-Calamovilfa longifolia Herbaceous Vegetation*
3-□	Three-Square	*Schoenoplectus pungens*	A	H	0.5-5M	V.A	V.A.5	N	V.A.5.N.l	A. 1433	*Schoenoplectus pungens Semi-permanently Flooded Herbaceous Alliance*	CEGL001587	*Schoenoplectus pungens Herbaceous Vegetation*
BUG	Buffalo grass	*Urochloa mutica*	T	A	<0.5	N/A	N/A	N/A	N/A	QVR_31	*Urochloa mutica Herbaceous Alliance*	QVR_31a	*Urochloa mutica Herbaceous Vegetation*
CH	Cheatgrass	*Bromus tectorum*	T	H	0.5-5M	V.D	V.D.2	N	V.D.2.N.d	A.1814	*Bromus tectorum Semi-natural Herbaceous Alliance*	QVR_27a	*Bromus tectorum Semi-natural Herbaceous Vegetation*
GG	Gamagrass	*Tripsacum dactyloides*	T	H	0.5-5M	N/A	N/A	N/A	N/A	NA	*N/A*	N/A	*N/A*

T= Terrestrial A= Aqatic W= Woodland F= Forest S=Shrub H=Herbaceous